

REVISION OF THE “APOCEPHALUS MIRICAUDA-GROUP”  
OF ANT-PARASITIZING FLIES  
(DIPTERA: PHORIDAE)

BRIAN V. BROWN<sup>1</sup>

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1. Natural History Museum of Los Angeles County,  
900 Exposition Boulevard, Los Angeles, California 90007.  
E-mail: bbrown@nhm.org.

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**ABSTRACT.** The “*Apocephalus miricauda*-group”, a paraphyletic assemblage, is revised and diagnosed. Seventy-three species are recognized, including the following 58 new to science: *A. acanthus*, *amplidiscus*, *annulatus*, *asyndetus*, *atrimarginatus*, *barbiventris*, *batillus*, *brevifrons*, *brochus*, *cardiacus*, *catholicus*, *comosus*, *conecitonis*, *conformalis*, *constrictus*, *contortiventris*, *contracticauda*, *crassilatus*, *curtinotus*, *cyclodiscus*, *deceptus*, *denotatus*, *dinoponerae*, *dracodermus*, *emargilatus*, *eurydomus*, *fenestratus*, *flexus*, *funditus*, *gigantivorus*, *glabriventris*, *globosus*, *incomptus*, *indeptus*, *indistinctus*, *inpalpabilis*, *intonsus*, *kungae*, *latinsulosus*, *lobicauda*, *maculosus*, *magnicauda*, *melinus*, *meniscus*, *orbiculus*, *pachycondylae*, *paldiae*, *petiolus*, *reticulatus*, *roeschardae*, *secus*, *spiculus*, *striativentris*, *strongylus*, *tanyurus*, *torulus*, *triangularis*, and



*trifidus*. The previously described species, all named by Borgmeier, are *A. densepilosus*, *digitalis*, *fuscipalpis*, *inimicus*, *lopesi*, *lyratus*, *minutus*, *miricauda*, *paraponerae*, *persecutor*, *piliventris*, *quadratus*, *spatulatus*, and *spatulicauda*. Additionally, a fossil species, *A. succineus* new species, is described from Dominican amber. The genus *Anaclinus* is considered a synonym of *Apocephalus*, and the one species, *A. lopesi*, is transferred to *Apocephalus* (new combination). The species *A. angularis* Borgmeier is considered a synonym of *A. minutus* (new synonym). Monophyletic groups within the *A. miricauda*-group include the *A. paraponerae*-subgroup, the *A. spatulatus*-subgroup, the *A. meniscus*-subgroup, the *A. miricauda*-subgroup, the *A. funditus*-subgroup, and the *A. spatulicauda*-subgroup. The “*A. miricauda*-group” is paraphyletic with respect to the *A. attophilus*-group. Most species are parasitoids of injured ponerine ants.

## INTRODUCTION

The genus *Apocephalus* Coquillett is a large group of parasitoid phorid flies, including the original “ant-decapitating flies” of the New World. Traditionally, the group has been organized into two subgenera: *Apocephalus* s. s. and *Mesophora*. Subgenus *Mesophora* was treated previously (Brown, 1993, 1994, 1996, 1997a), but only one subsection of subgenus *Apocephalus* has been revised (Brown, 1997b).

In this paper I treat the “*A. miricauda*-group” of species, a paraphyletic group I proposed previously (Brown, 1997b; hereafter the quotation marks around the name of this group, which indicate non-monophyly, will be omitted). These flies are parasitoids, mostly of ponerine ants (Hymenoptera: Formicidae: Ponerinae), and mostly of injured or distressed individual workers.

## METHODS AND MATERIALS

### METHODS

Methods are the same as my previous works on *Apocephalus*, but a comment on species concepts is necessary. Some of the proposed new species in this revision are extremely similar to each other; for instance *A. flexus* new species and *A. orbiculus* new species differ mostly by the shape of a small internal sclerite (Figs. 51 and 53). Although these differences seem marginal and possibly insignificant, they are based on characters that are not known to differ significantly within species. Additionally, recent work in phorid taxonomy has used extremely narrow species definitions (e.g., Disney, 1989), and some evidence exists for cryptic species within otherwise well-defined taxa. In summary, the new species descriptions contained herein are proposals that can be reevaluated when additional specimens have been collected.

The female ovipositor is described in a similar manner as that of *A. attophilus*-group species (Brown, 1997b), but one additional structure is present in many *A. miricauda*-group species, namely the internal, sclerotized loop derived from sternite 9. In many species it is a round structure with a broad, moderately sclerotized process (Fig. 106), but in some others it is darkly sclerotized and of different structure (Figs. 107–109).

**PHYLOGENETIC ANALYSIS.** The character states of the *A. spatulatus*-subgroup (Table 1) were analyzed using the computer program HENNIG-86 (Farris, 1989). Other cladograms were constructed by hand.

**TERMS AND NAMES.** The nomenclature of ant species was checked against Bolton (1995). One notable change from normal use is that the more commonly used *Eciton* “*burchelli*” (Westwood) has been changed to the correct *E. burchellii*, following Bolton.

Geographical coordinates are quoted as decimal de-

grees, rather than degrees, minutes and seconds (e.g., 90.5°W, rather than 90°30'W; Crawford, 1983).

**BARCODES.** In addition to the usual insect labels recording locality information, specimens were labeled with barcoded insect labels (Thompson, 1994) and data were recorded in a database. All barcoded labels that begin with the abbreviation “LACM ENT,” indicate that the Natural History Museum of Los Angeles County (LACM) is the institution where the data are stored. Specimens with barcoded labels beginning “INBIO” have their data stored at LACM and the Instituto Nacional de Biodiversidad in Costa Rica. To make later recognition of holotypes easier, I list their individual barcode number in square brackets.

### MATERIALS

This revision is based on adult female specimens. A few species are also known from males and immatures, but because of the highly incomplete record of these forms, they are not treated at this time.

Specimens belong to the following institutions (codens from Arnett et al., 1993; curator or collection manager names in parentheses):

|         |                                                                                                                                                      |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| AMNH    | Department of Entomology, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024-5192, U.S.A. (D. Grimaldi)        |
| BHMH    | Universidade Federal de Minas Gerais, Caixa Postal 486, 30.161-970, Belo Horizonte, MG, Brazil (R. Parentoni)                                        |
| DEBU    | Department of Environmental Biology, University of Guelph, Guelph, ON, Canada N1G 2W1 (S. Marshall)                                                  |
| EMUS    | Department of Biology, Utah State University, Logan, Utah 84322-5305, U.S.A. (W.J. Hanson)                                                           |
| INBC    | Instituto Nacional de Biodiversidad, A.P. 22-3100, Santo Domingo, Heredia, Costa Rica (M. Zumbado)                                                   |
| INPA    | Instituto Nacional de Pesquisas da Amazônia, Estrada do Aleixo, 1756, C.P. 478, 69.011 Manaus, Brazil (J. Rafael)                                    |
| LACM    | Entomology Section, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, CA 90007, U.S.A. (B. Brown)                 |
| LACM-IP | Invertebrate Paleontology Section, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, CA 90007, U.S.A. (L. Groves) |
| MCZC    | Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138, U.S.A. (on indefinite loan to B. Brown)                                      |
| MIUP    | Museo de Invertebrados Graham B. Fairchild, Universidad de Panama, Estafeta Universitaria, Panama (D. Quintero)                                      |

|         |                                                                                                                                                                      |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MUCR    | Museo de Insectos, Universidad de Costa Rica, San Pedro, San José, Costa Rica (P.S. Hanson)                                                                          |
| MUSM    | Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Av. Arenales 1267, Apartado 14-0434, Lima-14, Peru (G. Lamas)                                   |
| MZSP    | Museu de Zoologia, Universidade de São Paulo, Av. Nazaré 481, CP 7172, 01051 São Paulo, Brazil (F.C. do Val)                                                         |
| QCAZ    | Quito Catholic Zoology Museum, Departamento de Biología, Pontificia Universidad Católica del Ecuador, 12 de Octubre y Carrion, Apto. 2184, Quito, Ecuador (G. Onore) |
| ROME    | Department of Entomology, Royal Ontario Museum, 100 Queen's Park, Toronto, ON, Canada M5S 2C6 (D.C. Darling)                                                         |
| TAMU    | Department of Entomology, Texas A&M University, College Station, TX 77843, U.S.A. (R. Wharton)                                                                       |
| UCMS    | Department of Ecology and Evolutionary Biology, Box U-43, University of Connecticut, Storrs, CT 06269-3043 (J. O'Donnell)                                            |
| UGGG    | University of Guyana, Georgetown, Guyana (M. Tamessar)                                                                                                               |
| UNCB    | Museo de Historia Natural, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apto. 7495, Santa Fé de Bogotá, Colombia (E. Flores)                   |
| USNM    | United States National Museum, Smithsonian Institution, Washington, DC 20560, U.S.A. (on indefinite loan to B. Brown)                                                |
| USNM-IP | Department of Paleobiology, United States National Museum, Smithsonian Institution, Washington, DC 20560, U.S.A. (C. Labandeira)                                     |

Additionally, the abbreviation ALAS refers to the Arthropod Survey of La Selva Biological Station, Costa Rica.

## SYSTEMATICS

The monophyly of the many species groups of *Apocephalus* is still insufficiently established. In my previous work, I proposed that the *A. attophilus*-group was characterized by a separated apical sclerite (Brown, 1997b). Based on a more thorough knowledge of the *A. miricauda*-group, this character needs some refinement to allow it to diagnose the *A. attophilus*-group. Furthermore, as I previously suggested, there is no indication that the *A. miricauda*-group is monophyletic with respect to the *A. attophilus*-group. Instead, it appears to be a grade group relative to the *A. attophilus*-group.

There is some evidence that the *A. attophilus*-group and the *A. miricauda*-group together form a monophylum. Both have a distinctive ovipositor structure, in which most of the ovipositor is evenly, often lightly sclerotized, but apically there are darkened areas, particularly laterally. This condition is taken to represent the major synapomorphy of the species belonging to these two groups.

Another character state shared by the species of the two groups is that the cercus is straight in males, in contrast to the curved cercus found in many other species of the genus. The outgroup condition for this character is a straight cercus; there-

fore this is probably a plesiomorphic character state.

## PHYLOGENETIC HYPOTHESIS

The following character states were analyzed to provide an explanation of the relationships within the *A. miricauda*-group and the *A. attophilus*-group (Fig. 119):

1. Ovipositor with apical, lateral darkening (primitive state: without darkenings or darkening not lateral).
2. Ovipositor elongate (primitive state: ovipositor relatively short).
3. Dufour's mechanism elongate, with relatively large cells (primitive state: short, rounded Dufour's mechanism; cells small in center).

This character state is found in some members of the *A. miricauda*-group and all the *A. attophilus*-group species I have examined, such as *A. pseudocercus* Brown and *A. dichromatus* Brown (Figs. 114–115). Within the *A. miricauda*-group, the primitive state is found in the *A. paraponerae* (Fig. 117), *A. spatulatus*, and *A. miricauda*-subgroups. The outgroup condition is found in other *Apocephalus*, such as species of the *A. grandipalpis*-group (Fig. 116) and subgenus *Mesophora*.

4. Venter of ovipositor with separate apical sclerite (primitive state: venter not separated apically).

Some *A. miricauda*-group species look superficially like they should be placed in the *A. attophilus*-group, based on the structure of the dorsum of the ovipositor. Ventrally, however, these species have sternite 7 completely contiguous and unaffected by the separation of the apical sclerite from the ovipositor.

5. Apical sclerite with sclerotized connection to ovipositor restricted to thin, medial strip (primitive state: connection more extensive).
6. Anterior section of v-shaped darkening fused into a single process (primitive state: anterior section parallel, joining only at apex).

## HOST-PARASITOID RELATIONSHIPS

Most species of the *A. miricauda*-group are parasitoids of injured ants of the subfamily Ponerinae. In contrast, species of the *A. attophilus*-group attack healthy (noninjured) ants of the tribe Attini, subfamily Myrmecinae. Therefore, within the *A. attophilus*-group (including the *A. miricauda*-group), parasitism of ponerines is a plesiomorphic character state.

The hypothesized phylogenetic relationships among the phorid flies considered herein reflect similar ideas about ant phylogeny. Ponerines and myrmecines have been considered closely related in the past, but more recent reviews have discounted this relationship (e.g., Baroni Urbani et al., 1992). Ward (1994), however, has cast doubt upon confidence in the monophyly of Ponerinae and thus the



rejection of a sister-group relationship between ponerines and myrmecines.

If the Ponerinae is indeed paraphyletic relative to the Myrmecinae, it would lend support to the idea that host ants and parasitoid flies have coevolved, at least on a broad scale. This scenario would match the phylogeny in Fig. 119, in which parasites of the ponerines are paraphyletic with respect to parasitoids of the myrmecines. Many details need to be worked out, however, before this correlation between host and parasite phylogenies can be accepted as significant. For instance, although the *A. attophilus*-group species attack myrmecine ants, they attack only one small group, species of the fungus-growing ant genera *Acromyrmex* and *Atta*, although I have suggested that at least one species of the closely related *Trachymyrmex* probably is also attacked (Brown, 1997b). If coevolution of the groups was prevalent, then one would expect further myrmecines to be hosts. Because most species of the *A. attophilus*-group have unknown hosts, such a scenario of wider host range is still possible.

KEY TO GROUPS OF SUBGENUS  
*APOCEPHALUS*

- 1 Tergite 6 enlarged, wider than tergite 5, extended laterally on segment 6, often with greatly enlarged lateral setae . . . . . *A. pergandei*-group
- Tergite 6 of normal size, usually smaller and narrower than tergite 5, usually without greatly enlarged lateral setae . . . . . 2
- 2 Ovipositor dorsally concave, spatulate, with upturned apices (Figs. 37, 45) . . . . . *A. miricauda*-group (in part)
- Ovipositor dorsally flat or convex . . . . . 3
- 3 Ovipositor with apical section of ovipositor well differentiated from proximal section with clearly demarked narrowing at junction between the two, both dorsally and ventrally; sections articulating by at most a thin, median, sclerotized strip; v-shaped darkening usually anteriorly fused to form a long, single process; parasitoids of attine ants . . . . . *A. attophilus*-group
- Ovipositor with apical section not concurrently differentiated ventrally and dorsally; usually not differentiated into proximal and apical sections ventrally; anterior apex of v-shaped darkening not fused to form long, forward-directed, single process . . . . . 4
- 4 Ovipositor usually blunt-ending dorsally, often subparallel throughout length, with separated or differentiated proximal and apical sections dorsally; apical section often with lateral darkenings; some species with pointed, elongate ventral postapical sclerite on ovipositor that contrasts strongly with shape of dorsal apex; mostly parasitoids of injured ponerine ants . . . . . *A. miricauda*-group (in part)
- Ovipositor usually pointed dorsoapically, usually tapered posteriorly, not differentiated into separate anterior and posterior sections; if not pointed apically, then without lateral darkenings; ovi-

positor ventrally without pointed, postapical sclerite that contrasts strongly with shape of dorsal apex . . . . . other *Apocephalus*

*Apocephalus* Coquillett

*Apocephalus* Coquillett, 1901:501, fig. 1. Type species: *A. pergandei* Coquillett, by original designation. Gender masculine (Ride et al., 1985: Article 30a iii).

*Pseudoplastophora* Schmitz, 1915:327, figs. 6, 7. Type species: *P. caudataria* Schmitz, by monotypy. Synonymized by Borgmeier, 1968.

*Pleurophorina* Borgmeier, 1969:66, figs. 40-42. Type species: *P. turgida* Borgmeier, by original designation. Synonymized by Brown, 1997b.

*Zyziphora* Peterson and Robinson, 1976:119, figs. 1-5. Type species: *Z. hirtifrons* Peterson and Robinson, by original designation. Synonymized by Brown, 1992.

*Anaclinusa* Borgmeier, 1969:63-64, figs. 35-37. Type species: *Anaclinusa lopesi* Borgmeier, by original designation. New synonymy.

The genus *Anaclinusa* is here considered a synonym of *Apocephalus*, based on the single, unusual species *A. lopesi* (below).

*Apocephalus miricauda*-group

This is not a monophyletic group. It is here recognized in an informal sense to allow discussion of a group of species of a similar evolutionary grade. Almost all are parasitoids of injured ponerine ants, in contrast to their hypothesized relatives, the *A. attophilus*-group, which are parasitoids of healthy, uninjured attine ants.

*Apocephalus paraponerae*-subgroup

**DIAGNOSIS.** Ovipositor with ventral postapical sclerite that is usually apically pointed and triangular in shape (two species have apex truncate). Lateral, medially directed bars of sclerotization present at apex ventrally.

**FOSSIL RECORD.** There are seven pieces of Dominican amber (Oligocene-Miocene) that contain fossil phorids closely resembling *A. paraponerae* Borgmeier or *A. deceptus* new species. One of these pieces contains four specimens; another contains two. These are the oldest known fossils of this genus (Brown, 1999) and are treated in detail below.

**PHYLOGENETIC RELATIONSHIPS.** Species of this subgroup are apparently the most basal taxa in the *A. attophilus*-group.

Within the *A. paraponerae*-subgroup, three further divisions are apparent, based on the following characters (see also Fig. 120):

- 1. Dorsal, paired, preapical sclerites present on ovipositor (primitive state: no separate sclerites). This character state defines a group, herein called the *A. paraponerae*-series, containing *A. paraponerae*, *A. deceptus*, *A. strongylus* new species, *A. melinus* new species, and possibly *A.*

*roeschardae* new species (see discussion in species treatment of *A. roeschardae*). The highly aberrant *A. tanyurus* new species (see below) might also belong here.

2. Apex of ventral postapical sclerite truncate (primitive state: apex pointed).

This character state is shared by *A. melinus* and *A. roeschardae*.

3. Sternite 7 with anterior process (primitive state: sternite 7 broad).

This character state is shared by a number of species, herein called the *A. conecitonis*-series: *A. conecitonis*, *A. constrictus*, *A. crassilatus*, *A. dracodermus*, *A. indeptus*, *A. inpalpabilis*, and *A. reticulatus* (all new species).

### *Apocephalus paraponerae*-series

#### *Apocephalus paraponerae* Borgmeier (Figs. 1–2, 117)

*Apocephalus paraponerae* Borgmeier, 1958:324, figs. 8, 15.

**HOLOTYPE.** ♀, PANAMA: Barro Colorado Island, 19.vi.1956, C.W. & M.E. Rettenmeyer, *Paraponera clavata* nest entrance (University of Kansas; not examined).

**SPECIES RECOGNITION.** The ovipositor of this species is distinctive, with its long, thin, parallel lateral darkenings. The similar *A. deceptus*, below, has thicker lateral darkenings, smaller, thinner preapical sclerites, and usually more ventral setae on segment 6.

**DESCRIPTION.** Body length 1.4–2.1 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair to subequal in size to upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur slightly darker on anterior face. Mean costal length 0.57 wing length; range 0.53–0.59. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen yellow to gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with long seta at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting usually of single median pair but sometimes up to four setae present. Ovipositor (Figs. 1–2) straight in lateral view, slightly sclerotized, but with small pair of darker preapical sclerites. Lateral darkening thin, subparallel, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 broad, lightly sclerotized. Dufour's mechanism

round (Fig. 117). Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Widespread in lowland rain forest throughout the Neotropical Region.

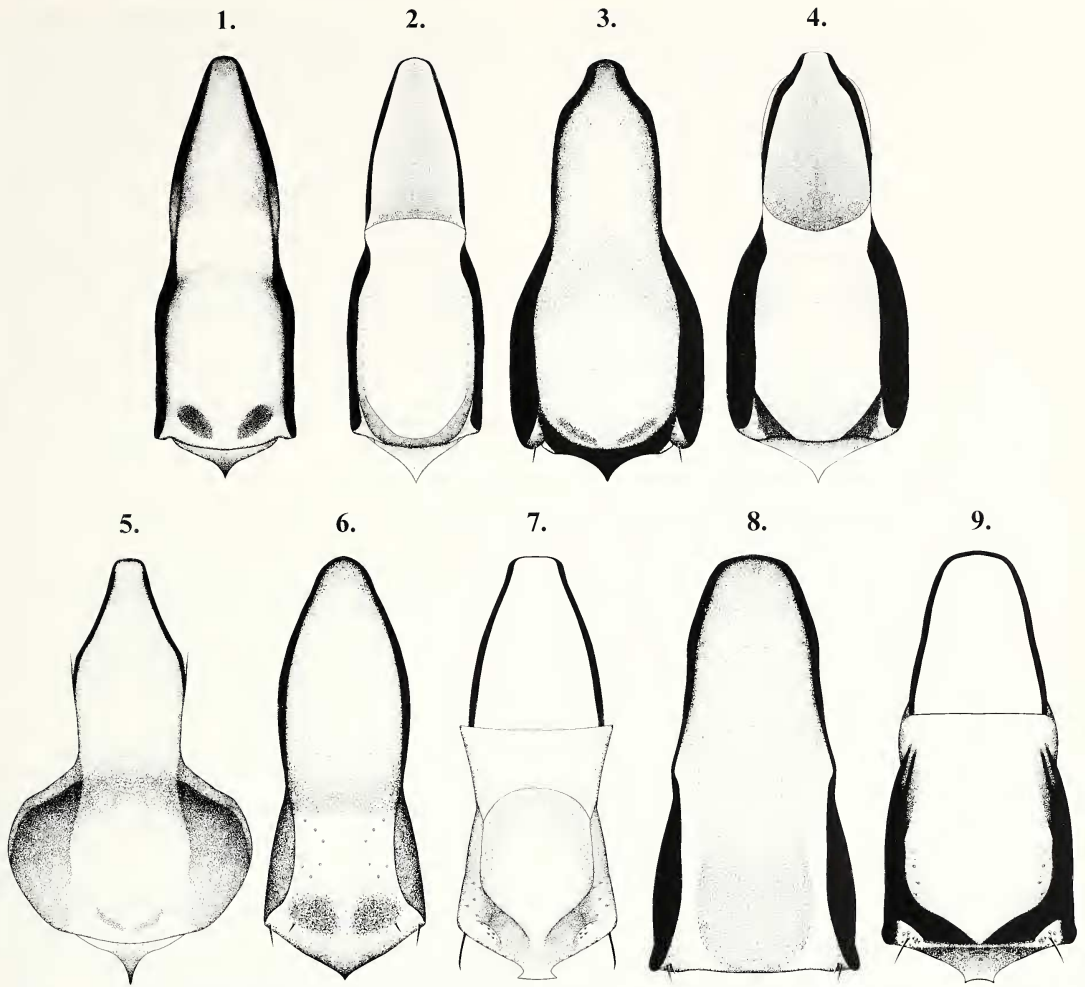
**WAY OF LIFE.** The life history of this species was studied by Brown and Feener (1991a, 1991b) and Feener et al. (1996). It is a parasitoid of injured and dying workers of *Paraponera clavata* but also attacks other ponerine ants such as *Ectatomma tuberculatum* (Olivier) and *Pachycondyla* spp. At least on the Osa Peninsula in Costa Rica, *A. paraponerae* must subsist entirely on *E. tuberculatum*, because *P. clavata* does not occur there (D. Feener, personal communication). No flies have been reared to adulthood from any host except *P. clavata*, but I have reared larvae from *Pachycondyla villosa* (Fabricius) and *E. tuberculatum*.

Females of *A. paraponerae* seem to adjust their clutch size to the size of the available host. When ovipositing in the much larger workers of *P. clavata*, females laid an average of 2.09 eggs/host ( $n = 11$ ,  $sd = 1.14$ ), whereas they laid an average of only 1.13 eggs on the smaller *E. tuberculatum* ( $n = 5$ ), *P. apicalis* ( $n = 1$ ; 1 egg), and *P. villosa* ( $n = 2$ ); the difference between the number of eggs laid on *P. clavata* versus the pooled mean for the smaller ant species was statistically significant (95%;  $T = 2.65$ ,  $p = 0.021$ ,  $df = 12$ ). As with other species in the *A. miricauda*-group, individual flies may be egg-layers or feeders (see Behavioral Aspects, below).

Based on behavioral characteristics and body size, Morehead and Feener (1997) have proposed that what is currently recognized as *A. paraponerae* may be a group of at least two races that are undergoing sympatric speciation. Specifically, they have proposed that individuals attacking *P. clavata* and *E. tuberculatum* are of different races. If this is true, then differences in the average clutch size of ovipositing females might be a characteristic of each race, not of individual choice by females. I have been unable to find consistent structural characters that separate females attacking *P. clavata* from those attacking other hosts.

**MATERIAL EXAMINED.** BRAZIL: Amazonas: Manaus, Reserva Ducke, 3.13°S, 60.02°W, 2♀, 8–15.iv.1992, J. Vidal, Arm. Cola. 1-B-1m (INPA); Rio de Janeiro, near Desengano State Park, site #2, 21.92°S, 41.80°W, 11♀, 10.v.1999, B. Brown, injured *Pachycondyla apicalis*, 200 m (LACM, MZSP), near Desengano State Park, site #3, 21.96°S, 41.81°W, 1♀, 7.v.1999, B. Brown, injured *Ectatomma tuberculatum*, 200 m (LACM), 2♀, 7.v.1999, B. Brown, injured *Ectatomma lugens*, 200 m (LACM), 6♀, 7.v.1999, B. Brown, injured *Pachycondyla villosa*, 200 m (LACM); Rondonia: 62 km SE Ariquemes, Fazenda Rancho Grande, 10.35°S, 62.80°W, 5♀, 14–25.ix.1993, B. Harris, 165 m, injured *Paraponera clavata* (LACM). COLOMBIA: Amazonas: Amacayacu National Park,





Figures 1–9. Ovipositors. Figures 1–2. *Apocephalus paraponerae* Borgmeier. 1. Dorsal. 2. Ventral. Figures 3–4. *Apocephalus deceptus* new species. 3. Dorsal. 4. Ventral. 5. *Apocephalus strongylus* new species, dorsal. Figures 6–7. *Apocephalus melinus* new species. 6. Dorsal. 7. Ventral. Figures 8–9. *Apocephalus roeschardae* new species. 8. Dorsal. 9. Ventral.

3.82°S, 70.26°W, 17♀, 30.viii.1997, B. Brown, G. Kung, injured *Paraponera clavata* (LACM), 2♀, 2.ix.1997, B. Brown, G. Kung, injured *Pachycondyla apicalis* (LACM), 8♀, 3.ix.1997, B. Brown, G. Kung, injured *Paraponera clavata* (LACM, UNCB), 1♀, 3.ix.1997, B. Brown, G. Kung, injured *Pachycondyla villosa* (LACM), 1♀, 5.ix.1997, B. Brown, G. Kung, injured *Dolichoderus attelaboides* (LACM), 7 km W Leticia, 4.13°S, 69.9°W, 1♀, 26.viii.1997, B. Brown, G. Kung, injured *Pachycondyla crassinoda* (LACM), 4♀, 26.viii.1997, B. Brown, G. Kung, injured *Pachycondyla apicalis* (LACM), 22 km NW Leticia, 4.04°S, 69.99°W, 1♀, 6.ix.1997, 5♀, 7.ix.1997, B. Brown, G. Kung, injured *Pachycondyla apicalis* (LACM); Valle: Rio Raposo, 3.67°N, 77.08°W, 2♀, x.1964, 1♀, vi.1965, V.H. Lee, light trap (LACM). COSTA RICA: Guanacaste: Finca Posmompá, near Pitilla, 11.05°N, 85.43°W, 8♀, 5–6.vii.1997, B. Brown, in-

jured *Pachycondyla villosa* (LACM), 26♀, 5–6.vii.1997, B. Brown, J. Paldi, injured *Paraponera clavata* (LACM); Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 23♂, 27♀, 19–26.v.1988, B. Brown, injured *Paraponera clavata* (LACM, MCZC), 2♀, 23–26.v.1988, B. Brown, Malaise trap SSO 50 (LACM) 3♂, 3♀, 22.iv.1989, B. Brown, D. Feener, on *Paraponera clavata* (LACM), 1♀, 8–15.v.1989, B. Brown, D. Feener, Malaise trap SOR@SHO (LACM), 20♀, 24.vi.1993, attracted to injured *Ectatomma tuberculatum* (LACM), 1♀, 24.vi.1993, B. Brown, injured *Pachycondyla apicalis* (LACM), 1♀, 26.vi–1.vii.1993, B. Brown and D. Feener, Malaise trap #3 (LACM), 1♀, 27.vi.1993, B. Brown, injured *Pachycondyla villosa* (LACM), 51♀, 27.vi.1993, D. Feener, *Paraponera* experiment vouchers (LACM), 4♀, 28.vi.1993, B. Brown, ovipositing on *Ectatomma tuberculatum* (LACM), 3♀, 2.vii.1993, B. Brown,

injured *Pachycondyla impressa*, 18♀, 2.vii.1993, D.H. Feener, attracted to injured *Ectatomma tuberculatum* (LACM), 1♀, 1–15.iii.1993, Malaise trap M/10/41, 1♀, 15.iv–1.v.1993, Malaise trap M/10/89, 2♀, 1–15.v.1993, Malaise trap M/10/104, 2♀, 18.v.1993, ALAS, Malaise trap, M/01/96, M/02/97 (INBC), 1♀, 15.v–1.vi.1993, Malaise trap M/08/114, 1♀, 15.v–1.vi.1993, Malaise trap M/10/116, 2♀, 1–15.vi.1993, Malaise trap M/10/132, 1♀, 15.vi–1.vii.1993, Malaise trap M/08/142, 1♀, 15.vi–1.vii.1993, ALAS, Malaise trap M/10/144 (INBC), 9♀, 15.vi–1.vii.1993, ALAS, Malaise trap M/12/146 (INBC), 1♀, 15.vi–1.vii.1993, ALAS, Malaise trap M/06/151 (INBC), 1♀, 15.vii.1993, ALAS, Malaise trap M/12/162 (INBC), 4♀, 3.viii.1993, ALAS, Malaise trap M/01/164, M/12/174 (INBC), 1♀, 16.ix.1993, ALAS, Malaise trap M/08/214 (INBC), 1♀, 15.x.1993, ALAS, Malaise trap M/12/246 (INBC), 1♀, 1.xii.1993, ALAS, Malaise trap M/01/276 (INBC), 1♀, 17.vii.1995, ALAS, Malaise trap M/10/407 (INBC), 1♀, 16.x.1995, ALAS, Malaise trap M/07/476 (INBC), 6♀, 25.vi.1997, B. Brown, J. Paldi, injured *Ectatomma tuberculatum* (LACM), 2♀, 7.vii.1998, ALAS, light L/18/415 (INBC), 1♀, 15.i.1998, ALAS, light L/??/274 (INBC), 1♀, 9.vii.1998, ALAS, light L/09/418 (INBC), 2♀, 22.vii.1998, ALAS, light L/17/426 (INBC), 1♀, 15.x.1998, ALAS, light L/08/489, Rara Avis, 10.28°N, 84.04°W, 1♀, 18–23.i.1989, D.A. Grimaldi (AMNH), 2♀, 10.vii.1993, B. Brown, attracted to injured *Paraponera clavata* (LACM), Estación Magsasay, Parque Nacional Braulio Carrillo, 1♀, iii.1991, A. Fernandez (INBC); Puntarenas: Coopemarti, 8 km S puente de Rio Rincon, 8.63°N, 83.47°W, 1♀, ii.1991, P. Hanson, Malaise trap, 30 m, primary rainforest (LACM), 3 km SW Rincon, 8.68°N, 83.48°W, 1♀, xii.1991, P. Hanson, Malaise trap (LACM), 5 km SW Rincon, 8.7°N, 83.51°W, 10♀, 4.vi.1998, B. Brown, injured *Pachycondyla apicalis* (LACM), Sirena, 8.48°N, 83.60°W, 16♀, 9.vii.1993, D. Feener, injured *Ectatomma tuberculatum* (LACM). ECUADOR: Napo: Yasuni Biological Research Station, 0.67°S, 76.39°W, 1♂, 3♀, 23.v.1996, B. Brown, injured *Paraponera clavata* (LACM), 1♀, 26.v.1996, J. Röschard, injured *Pachycondyla apicalis* (LACM); Pichincha: Rio Palenque Science Center, 0.60°S, 79.35°W, 1♀, 25.iv–6.vi.1996, P. Hibbs, Malaise trap, 200 m (LACM); Sucumbios: Añaña, 0.48°S, 76.38°W, 16♀, 10.ix.1997, P. DeVries, injured *Paraponera clavata* (LACM), Limoncocha, 0.40°S, 76.58°W, 3♂, 10♀, 27.vii.1970, C. Rettenmeyer, *Paraponera clavata*, #4606 (LACM), Sacha Lodge, 0.50°S, 76.50°W, 1♀, 22.ii–4.iii.1994, 3♀, 13–23.vi.1994, 1♀, 13–25.vii.1994, 1♀, 10–21.xi.1994, P. Hibbs, Malaise trap (LACM, QCAZ). GUYANA: Berbice: Dubulay Ranch, 5.68°N, 57.86°W, 8♀, 18.i.1999, B. Brown, injured *Paraponera clavata* (LACM, UGGG), Warniabo Creek, Dubulay Ranch, 5.66°N, 57.88°W, 16–20.i.1999, B. Brown, M. Sharkey, Malaise trap #9

(LACM). PANAMA: Canal Zone: Barro Colorado Island, 9.17°N, 79.83°W, 1♀ [no collector or date], associated with *Ectatomma tuberculatum* (LACM), 3♀, 27.vi.1956, C. and M. Rettenmeyer, *Paraponera clavata* (LACM), 1♀, vii.1967, W.W. Wirth, light trap (USNM), 1♂, 5♀, 10.i.1985, D.H. Feener, on *Paraponera*, #0873 (LACM), 1♀, 10–17.iii.1993, J. Pickering, Malaise trap #957 (LACM), 6♂, 6♀, 23.vi.1996, S. Morehead, injured *Paraponera clavata* (LACM); Darien: Cruce de Mono, 7.92°N, 77.62°W, 1♀, 6.ii–4.iii.1993, R. Cambra, J. Coronado, Malaise trap (MIUP); San Blas: Nusagandi Reserve, 9.33°N, 79°W, 1♀, 16–23.iv.1994, J. Pickering, Malaise trap #2862 (LACM). PERU: Madre de Dios: Pakitzta, 11.94°S, 71.28°W, 9♀, 13.ii.1992, 6♀, 14.ii.1992, B. Brown, D. Feener, injured *Paraponera clavata* (LACM, MUSM, USNM), 4♀, 27.ii.1992, B. Brown, D. Feener, injured *Pachycondyla crassinoda* (LACM), 2♀, 28.ii–4.iii.1992, B. Brown, D. Feener, Malaise trap #1 (LACM). VENEZUELA: Amazonas: Rio Mavaca Camp, 2.03°N, 65.10°W, 1♀, 16–27.iii.1989, D.A. Grimaldi (AMNH).

### *Apocephalus deceptus* new species (Figs. 3–4)

**SPECIES RECOGNITION.** This species most closely resembles *A. paraponerae* but has thicker lateral darkenings and more ventral setae on segment 6.

**DESCRIPTION.** Body length 1.5–1.8 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax yellow; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.53 wing length; range 0.53–0.54. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly and posteriorly emarginate, with long seta at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row. Ovipositor (Figs. 3–4) straight in lateral view, slightly sclerotized, but with small pair of darker preapical sclerites. Lateral darkening thin, subparallel (but slightly broader than those of *A. paraponerae*), margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 broad, lightly sclerotized. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.



**GEOGRAPHICAL DISTRIBUTION.** This species is known only from Amazonian Ecuador.

**WAY OF LIFE.** Females of this species are attracted to injured workers of *Pachycondyla commutata* (Roger), the presumed host.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for deceive, referring to the deceptive similarity of this species to *A. paraponerae*.

**HOLOTYPE.** ♀, ECUADOR: Sucumbios: Añagu, 0.48°S, 76.38°W, 11.ix.1997, P. DeVries, injured *Pachycondyla commutata* [LACM ENT 024208] (LACM).

**PARATYPES.** ECUADOR: Napo: Cuyabeno, 0.2°S, 76.3°W, 1 ♀, 14.vi.1996, J. Röschard, injured *Pachycondyla commutata* (LACM); 1 ♀, same data as holotype (LACM).

### *Apocephalus strongylus* new species

(Fig. 5)

**SPECIES RECOGNITION.** The combination of broad lateral darkenings and the pair of preapical, dorsal sclerites of the ovipositor serve to distinguish this species from its closest relatives.

**DESCRIPTION.** Body length 1.4 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair subequal in size to upper pair. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.5 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with long seta at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 5) straight in lateral view, slightly sclerotized, but with small pair of darker preapical sclerites. Lateral darkening broadened, rounded laterally, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor with triangular ventral postapical sclerite. Sternite 7 broad, lightly sclerotized. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in Brazil.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Greek *strongylos* for round, referring to the rounded apical portion of the ovipositor.

**HOLOTYPE.** ♀, BRAZIL: Pará: Tucuruí, 3.83°S, 49.67°W, 20.vii–8.viii.1982, J. Vidal, CDC trap [LACM ENT 038362] (INPA).

### *Apocephalus melinus* new species

(Figs. 6–7)

**SPECIES RECOGNITION.** This species can be recognized by the brown-colored lateral darkenings and the large, black, round preapical sclerites of the ovipositor.

**DESCRIPTION.** Body length 1.0–1.5 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.54 wing length; range 0.51–0.6. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen yellow to gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of four long setae emanating from a small sternite. Ovipositor (Figs. 6–7) straight in lateral view, slightly sclerotized, but with small pair of darker preapical sclerites. Lateral darkening thin, subparallel, margin yellowish brown, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor ventrally with apically truncate postapical sclerite. Sternite 7 broad, lightly sclerotized. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens.

**GEOGRAPHICAL DISTRIBUTION.** Known from Amazonian Ecuador and Colombia.

**WAY OF LIFE.** Males and females were attracted to injured workers of *Dolichoderus attelaboides* (Fabricius), and in one instance, *D. decollatus* Smith. Larvae were reared from *D. attelaboides*.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for honey-colored, referring to the yellowish-brown color of the ovipositor's lateral darkenings.

**HOLOTYPE.** ♀, ECUADOR: Napo: Yasuni Biological Research Station, 20.v.1996, B. Brown, injured *Dolichoderus attelaboides* [LACM ENT 053807] (LACM).

**PARATYPES.** COLOMBIA: Amazonas: Amacayacu National Park, 3.82°S, 70.26°W, 1 ♀, 31.viii.1997, B. Brown, G. Kung, injured *Dolichoderus decollatus* (LACM), 1 ♂, 9 ♀, 5.ix.1997, B. Brown, G. Kung, injured *D. attelaboides* (LACM, UNCB), 22 km NW Leticia, 4.04°S, 69.99°W, 1 ♀,



28.viii.1997, B. Brown, G. Kung, injured *Pachycondyla commutata* (LACM). ECUADOR: 5♂, 12♀, same data as holotype (LACM, MCZC, QCAZ, USNM).

### *Apocephalus roeschardae* new species

(Figs. 8–9)

**SPECIES RECOGNITION.** This species can be recognized by the truncate apex of the ventral postapical sclerite, its dark overall color, and the large, medial sclerotization instead of paired sclerites dorsally.

**DESCRIPTION.** Body length 1.4–2.0 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax yellow; pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur of even color anteriorly. Mean costal length 0.52 wing length; range 0.49–0.55. Wing vein  $R_{2+3}$  present. Halter mostly yellow but with dark brown spot on knob. Abdominal tergites dark brown. Venter of abdomen dark gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with long seta at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae emanating from a small sternite. Ovipositor (Figs. 8–9) straight in lateral view, with broad median sclerite. Lateral darkening thin, subparallel, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor ventrally with apically truncate postapical sclerite. Sternite 7 round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite a simple, round loop.

**GEOGRAPHICAL DISTRIBUTION.** Known from Atlantic coastal Brazil, Ecuador, and Colombia.

**WAY OF LIFE.** Adult females are attracted to injured workers of the myrmicine ant, *Cephalotes atratus* (Linnaeus). I observed one female ovipositing in the abdomen of the host.

**PHYLOGENETIC RELATIONSHIPS.** It is possible that *A. roeschardae* is the sister-species of *A. melinus*, although this is only one of the most parsimonious conclusions from the data presented above. The relationship is supported by the peculiarly truncate ventral postapical sclerite in these two species. It is contradicted by the lack of paired sclerites in *A. roeschardae*. The abdomen of *A. roeschardae* is unusually colored, being completely dark brown, in contrast to that in other *A. miricauda*-group species, which have at least the ventral membrane yellow. Also, the sclerotized portions of the ovipositor are unusually robust. Such changes might have modified the “missing” character states

to states unrecognizable as homologous with those found in *A. melinus*.

**DERIVATION OF SPECIFIC EPITHET.** This species is dedicated to Ms. Jacqueline Röschar, who helped with field work in Ecuador and independently collected many new parasitic phorid flies.

**HOLOTYPE.** ♀, COLOMBIA: Amazonas: Amacayacu National Park, 3.82°S, 70.26°W, 31.viii.1997, B. Brown, G. Kung, injured *Cephalotes atratus* [LACM ENT 093613] (UNCB).

**PARATYPES.** BRAZIL: Rio de Janeiro: near Desengano State Park, site #1, 21.87°S, 41.80°W, 2♀, 5.v.1999, 6♀, 9.v.1999, B. Brown, injured *Cephalotes atratus*, 200 m (LACM, MZSP). COLOMBIA: Amazonas: Leticia, 4.19°S, 69.93°W, 1♀, 25.viii.1997, 1♀, 8.ix.1997, B. Brown, G. Kung, injured *C. atratus* (LACM), 22 km NW Leticia, 4.04°S, 69.99°W, 3♀, 28.viii.1997, injured *C. atratus* (LACM, UNCB). ECUADOR: Napo: Jatun Sacha, 1.07°S, 77.6°W, 1♀, 16.ix.1996, J. Röschar, injured *C. atratus* (LACM), Yasuni Biological Research Station, 0.67°S, 76.39°W, 1♀, 21.v.1996, 1♀, 22.v.1996, B. Brown, injured *C. atratus*, 220 m (LACM, QCAZ). PERU: Madre de Dios: Pakitza, 11.94°S, 71.28°W, 1♀, 4.ix.1991, T. Erwin, M. Pogue, fog tree #184 (USNM).

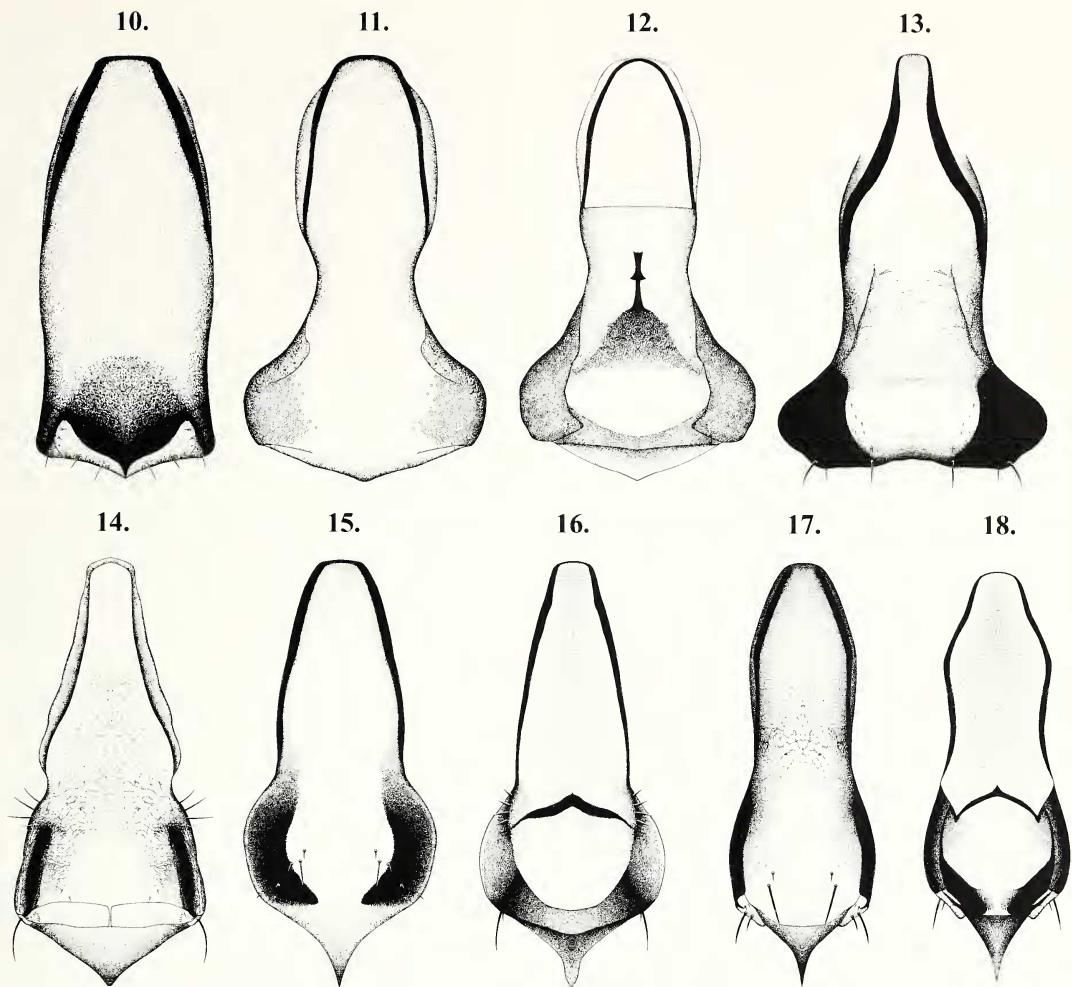
### *Apocephalus conecitonis*-series

#### *Apocephalus conecitonis* new species

(Fig. 10)

**SPECIES RECOGNITION.** Although similar to *A. secus*, this species differs by the shape of the ovipositor and setation of the venter, as outlined in the key. The apex of the ovipositor also is markedly downturned in this species.

**DESCRIPTION.** Body length 1.0–1.5 mm. Frons dark brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur of even color anteriorly. Mean costal length 0.46 wing length; range 0.46–0.48. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with long seta at posterolateral corner. Venter of segments 4–5 with row of setae on posterior margin. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row. Ovipositor (Fig. 10) downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening short, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor pointed. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 short, narrow. Dufour's mechanism not



Figures 10–18. Ovipositors. 10. *Apocephalus conecitonis* new species, dorsal. Figures 11–12. *Apocephalus constrictus* new species. 11. Dorsal. 12. Ventral. 13. *Apocephalus crassilatus* new species, dorsal. 14. *Apocephalus dracodermus* new species, dorsal. Figures 15–16. *Apocephalus indeptus* new species. 15. Dorsal. 16. Ventral. Figures 17–18. *Apocephalus inpalpabilis* new species. 17. Dorsal. 18. Ventral.

seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known only from the area of La Selva, Costa Rica.

**WAY OF LIFE.** Females of this species are associated with army ant raids, but it is not clear which ants they parasitize. It is possible that they are associated with army ants as a means to procure their actual hosts (Brown and Feener, 1998). On one occasion I collected these flies in association with a raid of *Eciton lucanoides* Emery on *Pachycondyla obscuricornis* (Emery), a ponerine ant and possible host; however, the army ants also were attacking *Paratrechina longicornis* (Latreille) and *Aphaenogaster araneoides* Emery.

**DERIVATION OF SPECIFIC EPITHET.** The name is from the Latin word *con*, for “with,” and

*eciton*, the name of army ants, referring to the association of these flies with ants of the genus *Eciton* Latreille.

**HOLOTYPE.** ♀, COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 2♀, 25.iv.1989, B. Brown, *Eciton burchellii* raid [LACM ENT 012251] (LACM).

**PARATYPES.** COSTA RICA: Heredia: Chila-mate, 10.45°N, 84.08°W, 2♀, v.1989, 1♀, iv–vi.1990, P. Hanson, Malaise trap (LACM), La Selva Biological Station, 10.43°N, 84.02°W, 2♀, 25.iv.1989, 44♀, 11.v.1989, 26♀, 13.v.1989, 1♀, 14.v.1989, 24♀, 16.v.1989, 15♀, 20.v.1989, B. Brown, D. Feener, *Eciton burchellii* raid (LACM, MCZC, MUCR, MZSP, USNM), 1♀, 2.iii.1993, ALAS, M/05/20 (INBC), 1♀, 1–15.iii.1993, ALAS, Malaise trap M/07/38, 2♀, 1–15.iv.1993, ALAS, Malaise trap M/05/68, M/11/74 (INBC), 1♀,



1.vi.1993, ALAS, Malaise trap M/12/118 (INBC), 4♀, 15.vi-1.vii.1993, ALAS, Malaise trap M/10/144 (INBC), 2♀, 3.vii.1993, B. Brown, *E. lucanoides* raid (LACM), 1♀, 4.iv.1994, ALAS, Malaise trap M/11/389 (INBC).

### *Apocephalus constrictus* new species

(Figs. 11–12)

**SPECIES RECOGNITION.** The unusually shaped ovipositor, with its extreme narrowing at midlength, is distinctive for this species (Figs. 11–12).

**DESCRIPTION.** Note that this description is somewhat fragmentary because it is based on a single, air-dried specimen. I hope that additional specimens will be found so that the missing character states can be included.

Body length 1.3 mm. Frons dark brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair subequal in size to upper pair. Flagellomere 1 brown, oval. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur of even color anteriorly. Mean costal length 0.54 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Ovipositor (Figs. 11–12) constricted at midlength, slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening broadened, rounded laterally, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 triangular, with narrow anterior projection. Internal sclerite rounded, with a short process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single, mid-elevation site in Costa Rica.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is from a Latin word for constricted, referring to the marked narrowing of the ovipositor at midlength.

**HOLOTYPE.** ♀, COSTA RICA: Puntarenas: Monteverde, 20–24.vi.1986, W. Hanson, G. Bohart [LACM ENT 012778] (EMUS).

### *Apocephalus crassilatus* new species

(Fig. 13)

**SPECIES RECOGNITION.** This species can be recognized easily by the broad, curved lateral margins of ovipositor and dense ventral setae of the abdomen.

**DESCRIPTION.** Body length 1.6–2.3 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair subequal in size to upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown.

Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.55 wing length; range 0.52–0.58. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites yellow, posteriorly dark brown; tergite 6 completely yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with long seta at posterolateral corner. Venter of segments 3–5 with long, dense setae concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 13) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening broadened, rounded laterally, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 broad, lightly sclerotized. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens.

**GEOGRAPHICAL DISTRIBUTION.** There are records of this species from Costa Rica, Panama, Colombia, and Brazil.

**WAY OF LIFE.** Females were attracted to injured workers of various species of *Pachycondyla*, including *P. apicalis* (Latreille), *P. impressa* (Roger), *P. unidentata* Mayr, and *P. villosa*.

**DERIVATION OF SPECIFIC EPITHET.** The name is a combination of the Latin words *crassus* and *latus*, referring to the wide lateral darkenings.

**HOLOTYPE.** ♀, COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 22.vi.1993, B. Brown, injured *Pachycondyla villosa* [LACM ENT 001551] (LACM).

**PARATYPES.** BRAZIL: Minas Gerais: Belo Horizonte, Estação Ecológica, UFMG campus, 1♀, 2–5.vii.1993, S.D. Gaimari, Malaise trap (BHMH). COLOMBIA: Amazonas: Amacayacu National Park, 3.82°S, 70.26°W, 2♀, 2.ix.1997, B. Brown, G. Kung, injured *Pachycondyla apicalis* (LACM, UNBC). COSTA RICA: Alajuela: 20 km S Upala, 1♀, 11–21.vi.1991, F.D. Parker [Malaise trap] (EMUS); Guanacaste: Finca Posmompá, near Pitilla, 11.05°N, 85.43°W, 2♀, 6.vii.1997, B. Brown, J. Paldi, injured *P. villosa* (LACM); Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 1♀, 24.vi.1993, 2♀, 6.vii.1993, B. Brown, injured *P. apicalis* (LACM) 1♀, 1.xi.1993, ALAS, Malaise trap M/02/249 (INBC), 2♀, 21.iii.1995, B. Brown, injured *P. villosa* (LACM), Plástico, 10.28°N, 84.02°W, 1♂, 3♀, 11.vii.1993, B. Brown, injured *P. unidentata* (LACM), Rara Avis, 12 km SW Horquetas, 1♀, 18–23.i.1989, D.A. Grimaldi, 550 m (AMNH). PANAMA: Canal Zone: Barro Colorado Island, 9.17°N, 79.83°W, 1♀, 25.viii–1.ix.1993, J. Pickering, Malaise trap #1676 (MIUP), 1♀,



19.viii.1996, S. Morehead, injured *P. impressa* (LACM).

### *Apocephalus dracodermus* new species

(Fig. 14)

**SPECIES RECOGNITION.** This species can be diagnosed by the reticulate surface and the slight narrowing at the midpoint of the ovipositor.

**DESCRIPTION.** Body length 1.1 mm. Frons dark brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur slightly darker on anterior face. Mean costal length 0.44 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with long seta at posterolateral corner. Venter of segments 3–5 with row of setae on posterior margin. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 14) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening broadened, rounded laterally, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor emarginate on either side, with long medial process. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 broad, lightly sclerotized. Abdominal glands in segment 5 white, inconspicuous in cleared specimens.

**GEOGRAPHICAL DISTRIBUTION.** Known only from a single site in Amazonian Peru.

**WAY OF LIFE.** The single specimen was collected over a raid of the army ant *Labidus spininodis* (Emery). Whether it was attracted to the army ants or to some victim of their raid is unknown (see Brown and Feener, 1998).

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin word *draco* for lizard and the Greek *derma* for skin, referring to the reticulate pattern on the ovipositor.

**HOLOTYPE.** ♀, PERU: Madre de Dios: Zona Reserva Manu, Pakitza, 17.ii.1992, B. Brown, D. Feener, raid *Labidus spininodis*, 360 m [LACM ENT 011897] (MUSM).

### *Apocephalus indeptus* new species

(Figs. 15–16)

**SPECIES RECOGNITION.** This species has a slightly rounded look to the apex of the ovipositor. It is separated from the similar *A. inpalpabilis* by having two pairs of supra-antennal setae and by the lateral bars of the venter of the ovipositor, which meet medially (Fig. 16).

**DESCRIPTION.** Body length 1.0–1.1 mm. Frons

dark brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur of even color anteriorly. Mean costal length 0.45 wing length; range 0.45–0.46. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with long seta at posterolateral corner. Venter of segments 3–5 with a few, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 15–16) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening broadened, rounded laterally, extended anteriorly on ovipositor; margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor with triangular ventral postapical sclerite. Sternite 7 round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from single sites in Costa Rica and Ecuador.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for reached or attained, referring to the lateral darkenings that extend farther anteriorly onto the ovipositor than those of some related species.

**HOLOTYPE.** ♀, COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 26.vi–1.vii.1993, B. Brown, D. Feener, Malaise trap #3 [LACM ENT 013220] (LACM).

**PARATYPES.** COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 3♀, 16.ii–2.iii.1993, ALAS, Malaise trap M/07/22, M/05/20, 1♀, 15.iii.1993, ALAS, Malaise trap M/07/38 (INBC). ECUADOR: Pichincha: 17 km E Santo Domingo, Tinalandia, 2♀, 6–13.v.1987, B. Brown, 710 m, windows (LACM).

### *Apocephalus inpalpabilis* new species

(Figs. 17–18)

**SPECIES RECOGNITION.** This species differs from the similar *A. indeptus* by having a single pair of supra-antennal setae and the lateral bars not reaching the center of the ovipositor (Fig. 18).

**DESCRIPTION.** Body length 1.3 mm. Frons dark brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 brown, oval. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal

to posterior setulae of scutum. Legs yellow; apex of hind femur slightly darker on anterior face. Mean costal length 0.47 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with long seta at posterolateral corner. Venter of segments 3–5 with a few, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 17–18) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening broadened, rounded laterally, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 broad, lightly sclerotized. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known only from La Selva, Costa Rica.

**WAY OF LIFE.** This fly was collected over a swarm raid of the army ant *Eciton burchellii*. Its host is unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin prefix *in*, meaning not, combined with *palpabilis*, meaning touchable, referring to the ventral, transverse sclerites of the ovipositor, which do not touch.

**HOLOTYPE.** ♀, COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 13.v.1989, B. Brown, *Eciton burchellii* swarm raid [LACM ENT 011326] (LACM).

### *Apocephalus reticulatus* new species

(Figs. 19–20)

**SPECIES RECOGNITION.** The namesake reticulations of the ovipositor are visible with light microscopy; otherwise, the forked ventral process (Fig. 20) is distinctive.

**DESCRIPTION.** Body length 1.1–1.4 mm. Frons dark brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron light brown to white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face (restricted to apical margin). Mean costal length 0.47 wing length; range 0.44–0.5. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with long seta at posterolateral corner. Venter of segments 3–4 bare, segment 5 with a single row of setae on posterior margin. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row.

Ovipositor (Figs. 19–20) slightly downturned apically, lightly but evenly sclerotized dorsally and with reticulate sculpture. Lateral darkening short, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor emarginate on either side, with long medial process. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 broad, with forked anterior process. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known only from a mid-elevation site in Costa Rica.

**WAY OF LIFE.** Unknown. One specimen was collected over a raid of the army ant *Labidus praedator* (F. Smith).

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for net-like, referring to the pattern on the dorsal surface of the ovipositor.

**HOLOTYPE.** ♀, COSTA RICA: San José: Zurquí de Moravia, 10.05°N, 84.02°W, 1–15.vi.1993, P. Hanson, Malaise trap, 1600 m [LACM ENT 053562] (LACM).

**PARATYPES.** COSTA RICA: San José: Zurquí de Moravia, 10.05°N, 84.02°W, 1♀, ix–x.1990, 1♀, ii.1991, 1♀, xii.1991–ii.1992, 6♀, v.1992, 5♀, vii.1992, 1♀, iv–v.1993, 5♀, vi.1993, 3♀, ix–x.1993, 1♀, i.1996, P. Hanson, Malaise trap, 1600 m (INBC, LACM, MCZC, MUCR, USNM), 1♀, 8.iii.1995, B. Brown, J. Cantley, over raid of *Labidus praedator* (LACM).

### Other *A. paraponerae*-subgroup Species

*Apocephalus persecutor* Borgmeier  
(Fig. 20)

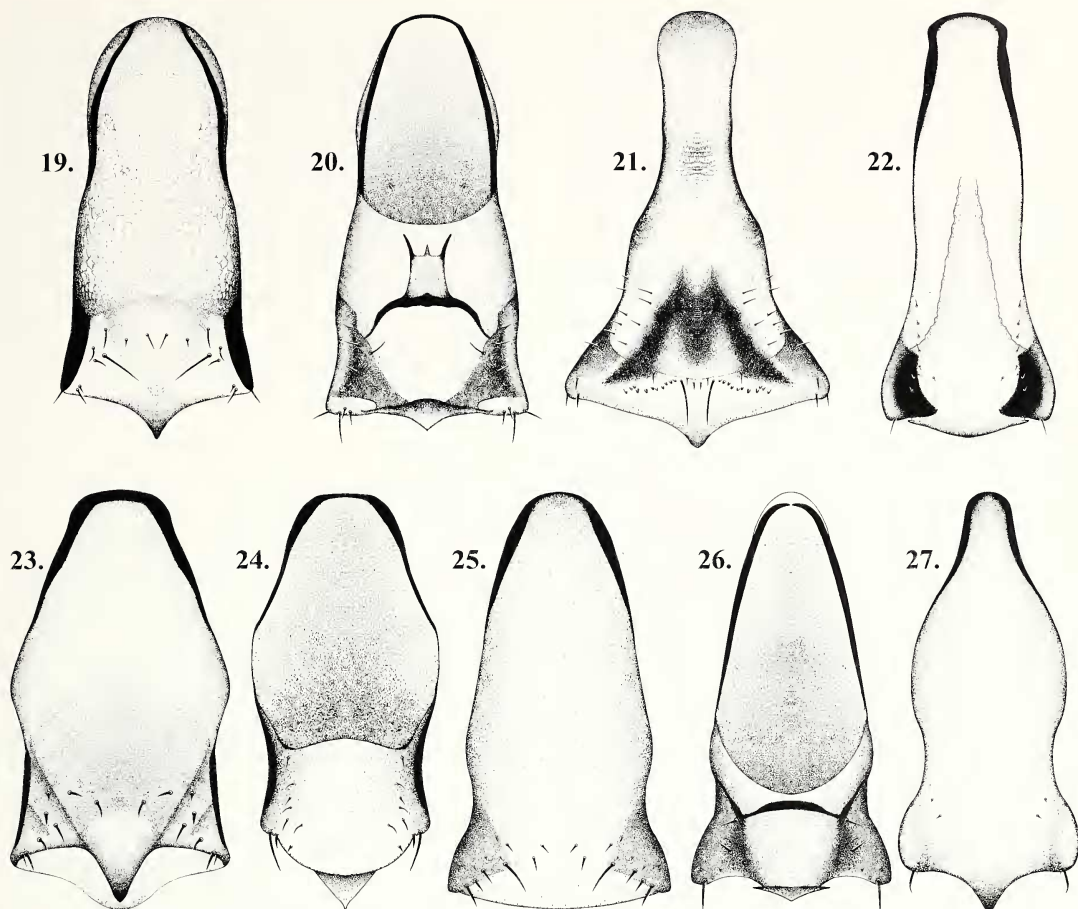
*Apocephalus persecutor* Borgmeier, 1961:44, figs. 54, 80.

**HOLOTYPE.** ♀, BRAZIL: Goiás: Campinas, 26.v.1933, J.S. Schwarzmaier, with *Nomomyrmex ensenbecki* (MZSP; examined).

**SPECIES RECOGNITION.** This species is easily recognized by the triangular ovipositor. It is similar to *A. dichocercus* Borgmeier (1958), a species I did not examine. Borgmeier (1971) separated these two species on the basis of the shorter costa in *A. persecutor* (0.38, versus 0.57 for *A. dichocercus*). Further study of *A. dichocercus* is needed.

**DESCRIPTION.** Body length 1.0–1.1 mm. Frons dark brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur slightly darker on anterior face. Mean costal length 0.39 wing length; range 0.38–0.40. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow to gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with setae of





Figures 19–27. Figures 19–20. *Apocephalus reticulatus* new species. 19. Dorsal. 20. Ventral. 21. *Apocephalus persecutor* Borgmeier, dorsal. 22. *Apocephalus curtinotus* new species, dorsal. Figures 23–24. *Apocephalus secus* new species. 23. Dorsal. 24. Ventral. Figures 25–26. *Apocephalus spiculus* new species. 25. Dorsal. 26. Ventral. 27. *Apocephalus torulus*, dorsal.

medium length along posterior margin. Venter of segments 3–5 with row of setae on posterior margin. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row. Ovipositor (Fig. 20) straight in lateral view, lightly sclerotized anteriorly; posteriorly with darkly sclerotized triangle; expanded. Lateral darkening not differentiated. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 not differentiated. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from Ecuador and Costa Rica.

**WAY OF LIFE.** The host of this species is unknown, but it has been collected with various species of army ants.

**MATERIAL EXAMINED.** COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 1♀, ix.1992, P. Hanson, Malaise trap (LACM), 2♀, 1–15.iv.1993, ALAS, Malaise trap M/04/67, M/05/68, (INBC), 1♀, 15.v–1.vi.1993, ALAS, Malaise trap M/8/114 (INBC). ECUADOR: Napo: Limoncocha, 0.40°S, 76.58°W, 1♀, 9.xi.1967, C. and M. Rettenmeyer, with *Eciton mexicanum*, E-528, #3673 (UCMS), 1♀, 13.xii.1967, with *E. lucanoides*, E-618, #4108 (UCMS); Pichincha: Rio Palenque Science Center, 3♀, 1–3.v.1987, *E. burchellii* bivouac, B. Brown (LACM).

#### *Apocephalus curtinotus* new species (Fig. 22)

**SPECIES RECOGNITION.** This species has a peculiar, medial darkening of the dorsum, as well as a rounded apical region of the ovipositor.

**DESCRIPTION.** Body length 1.3 mm. Frons



light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 complete, with long seta at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row. Ovipositor (Fig. 22) slightly downturned apically, with broad median sclerite. Lateral darkening broadened, rounded laterally, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 broad, lightly sclerotized. Abdominal glands in segment 5 dark, enlarged, elongate, clearly visible in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in Amazonian Brazil.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin words *curtus* for short and *nota* for mark, referring to the short lateral darkenings.

**HOLOTYPE.** ♀, BRAZIL: Amazonas: Manaus, Reserva Ducke, 3.13°S, 60.02°W, 6–17.vii.1992, J. Vidal, Arm. Cola, 1-B-20 m [LACM ENT 008385] (INPA).

### *Apocephalus secus* new species

(Figs. 23–24)

**SPECIES RECOGNITION.** This species is most similar to *A. conecitonis*, from which it differs by the shape of the ovipositor and the ventral setation, as outlined in the key. It also resembles *A. spiculus* new species, which has a much shorter ventral postapical sclerite.

**DESCRIPTION.** Body length 1.0 mm (both specimens). Frons light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus light brown. Dorsum of thorax light brown; pleuron white to brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur slightly darker on anterior face. Mean costal length 0.47 wing length; range 0.47–0.48. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow to gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emar-

ginate, with long seta at posterolateral corner. Venter of segments 3–5 with a few, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row; lateral setae shorter. Ovipositor (Figs. 23–24) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening short, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor emarginate on either side, with long medial process. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 not differentiated. Dufour's mechanism not seen. Abdominal glands in segment 5 white, invisible in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known only from a single, mid-elevation site in Costa Rica.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for different, referring to the fact that although this species is closely similar to *A. conecitonis*, *A. reticulatus*, and *A. torulus* new species, it differs in a few key characters.

**HOLOTYPE.** ♀, COSTA RICA: Puntarenas: Las Alturas, 8.95°N, 82.38°W, i.1992, P. Hanson, Malaise trap [LACM ENT 016169] (LACM).

**PARATYPE.** 1♀, same data as holotype, except v.1992 (LACM).

### *Apocephalus spiculus* new species

(Figs. 25–26)

**SPECIES RECOGNITION.** This species is recognized by the distinctive short ventral postapical sclerite of the ovipositor (Fig. 26).

**DESCRIPTION.** Body length 1.0 mm. Frons dark brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length. Wing vein  $R_{2+3}$  present. Halter light brown. Abdominal tergites dark brown. Venter of abdomen white. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with long seta at posterolateral corner. Venter of segments 3–5 with row of setae on posterior margin, but rows somewhat irregular. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row. Ovipositor (Figs. 25–26) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening short, apically rounded, divergent, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor emarginate on either side, with long medial process. Apicoventral margin of ovi-

positor straight. Ovipositor with small, triangular ventral postapical sclerite. Sternite 7 broad, without anterior process. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in Panama.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a diminutive of the Latin word *spica*, for spike, referring to the small apical triangle of the ovipositor.

**HOLOTYPE.** ♀, PANAMA: San Blas: Nusagandi Reserve, 9.33°N, 79.0°W, 5–12.ii.1994, J. Pickering, Malaise trap #2042 [LACM ENT 101299] (LACM).

### *Apocephalus torulus* new species

(Fig. 27)

**SPECIES RECOGNITION.** This species can be separated from other small species similar to *A. conecitonis* by the rounded, lobe-shaped apices of the lateral darkenings.

**DESCRIPTION.** Body length 0.9–1.0 mm. Frons dark brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length; range 0.44–0.49. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow to gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with long seta at posterolateral corner. Venter of segments 3–5 with row of setae on posterior margin. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row; lateral setae shorter. Ovipositor (Fig. 27) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening short, apically rounded, divergent, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor emarginate on either side, with long medial process. Apicoventral margin of ovipositor straight. Ovipositor with triangular ventral postapical sclerite. Sternite 7 broad, without anterior process. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from two sites in western Colombia and Ecuador.

**WAY OF LIFE.** Unknown. Most specimens were collected with a raid of *Labidus praedator*, but we did not observe any oviposition attempts directed at the ants.

**DERIVATION OF SPECIFIC EPITHET.** The

name is a Latin word for a small, rounded projection, referring to the lateral darkenings of the ovipositor.

**HOLOTYPE.** ♀, ECUADOR: Esmeraldas: Bilsa Biological Station, 0.34°N, 79.71°W, 8.v.1996, B. Brown, P. Hibbs, J. Cantley, raid *Labidus praedator* [LACM ENT 025275] (LACM).

**PARATYPES.** COLOMBIA: Valle: Rio Raposo, 1 ♀, viii.1965, V. Lee, light trap (USNM). ECUADOR: 6 ♀, same data as holotype (LACM, QCAZ).

### *Apocephalus succineus* new species

**SPECIES RECOGNITION.** This is the only species of *Apocephalus* in Dominican Republic amber that has a broad ovipositor, similar in appearance to that of *A. paraponerae*. There are other, undescribed species of *Apocephalus* in this amber, but all have much narrower ovipositors.

Unlike the extant species that it resembles, *A. succineus* apparently lacks dorsal, paired, preapical sclerites. It has a row of long setae on the posterior margins of the venter of abdominal segments 5 and 6 as well as scattered, slightly smaller setae.

**DESCRIPTION.** All specimens of this species are preserved in Dominican Republic amber. All show some evidence of decay and shrivelling, probably because they decomposed to some extent after being caught on the surface of the amber but before being covered with a final coating of resin. Because of this imperfect preservation, a number of character states cannot be seen clearly. When a particularly important character state can be seen best in a single specimen other than the holotype, it is noted in the following description.

Two pairs of supra-antennal setae present. Flagellomere 1 appearing elongate, narrow (possibly an artifact of shrivelling). Palpus normal, small. Anterior scutellar seta enlarged, longer than one-half posterior seta (easily seen in specimen DR-14-105). Mean costal length 0.44 wing length; range 0.44–0.45. Wing vein  $R_{2+3}$  present. Abdominal tergites of normal form. Tergite 6 undivided, tapered posteriorly; without large posterior setae (best seen in JW, March 1996–10). Venter of abdominal segments 5 and 6 with scattered, long setae; longest setae in posterior row of each segment (seen in DR-14-211). Abdomen without dense lateral setae. Ovipositor broad, straight in lateral view, lightly sclerotized, apparently without preapical sclerites (similar to Fig. 1, but lacking paired, preapical sclerites). Lateral darkening thin, subparallel, margin dark, complete. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor not seen but apparently with triangular, postapical sclerite. The actual separation of the ovipositor and the triangular postapical sclerite cannot be seen, so it cannot be ruled out that the postapical sclerite is actually fused to the ovipositor, which would be a relatively primitive character state. Sternite 7 not differentiated. Dufour's mechanism, abdominal glands, and internal sclerite not seen.



**AGE OF FOSSILS.** Dominican amber is assumed to have been deposited in the early to middle Miocene, 15–20 million years ago (Iturralde-Vinent and MacPhee, 1996).

**WAY OF LIFE.** Unknown. Given that this species is similar to *A. paraponerae*, a possible host would be the Dominican amber fossil ant *Paraponera dieteri* Baroni Urbani (1994). The genus *Paraponera*, with its single extant species *P. clavata* (Fabricius), no longer occurs on Hispaniola. Presumably, neither do species of the *A. paraponerae*-series, although collecting has been so limited in this region that such an assumption could not be made with absolute certainty.

Phorids that parasitize injured hosts are expected to be relatively common in amber (Brown, 1997c). Hosts that were caught in amber probably emitted alarm pheromones that attracted the parasitoids, which in turn became trapped.

**DERIVATION OF SPECIFIC EPITHET.** The name is from a Latin word, *succinum*, for amber.

**HOLOTYPE.** ♀, DOMINICAN REPUBLIC AMBER. Santiago/Puerto Plata area (LACM-IP).

**PARATYPES.** DOMINICAN REPUBLIC AMBER. 1♀, north mines, DR-14-211, 4♀, north mines, DR-14-105 (AMNH). 2♀, #3804 (USNM-IP). 1♀, DM, March 1993–5, 1♀, JW, March 1996–10 (Private collection of Mr. Pat Craig).

*A. spatulatus*-subgroup

**DIAGNOSIS.** This group can be diagnosed by the first two synapomorphies listed below (under Phylogenetic relationships). The ovipositors of many of the included species do not resemble other *A. miricauda*-group species, but some still retain the distinctive lateral darkenings (e.g., Figs. 32, 33, 43, 44, 46).

**PHYLOGENETIC RELATIONSHIPS.** A hypothesis of the relationships of some of the species within this group is possible (Table 1, Fig. 121). The following are proposed synapomorphic character states:

- 1. Ovipositor spatulate, dorsally concave (primitive state: ovipositor flat or convex).
- 2. Ovipositor with sclerotization of dorsal, apical region extending ventrally, completely encircling the ovipositor (primitive state: dorsal and ventral sclerotization not so confluent).
- 3. Ovipositor with medial, narrow, elongate, bluntly ending, dorsoapical process (primitive state: dorsal apex of ovipositor without process).
- 4. Ventral apex of ovipositor drawn out into long, extremely thin, filament-like process; substates: (1) long, (2) short (primitive state: apex terminating much more bluntly).

According to the cladogram, the short process in *A. acanthus* new species and *A. spatulatus* Borgmeier is the result of secondary reduction. In *A. striativentris* new species and *A.*

Table 1. Character state matrix for *A. spatulatus*-group.

|                       |            |
|-----------------------|------------|
| Outgroup              | 0000000000 |
| <i>incomptus</i>      | 1100000000 |
| <i>striativentris</i> | 1100000000 |
| <i>brochus</i>        | 1100000001 |
| <i>fuscipalpis</i>    | 1100000001 |
| <i>digitalis</i>      | 1110000000 |
| <i>denotatus</i>      | 1110000000 |
| <i>pachycondylae</i>  | 1101000000 |
| <i>atrimarginatus</i> | 1101000000 |
| <i>batillus</i>       | 1101000000 |
| <i>emargilatus</i>    | 1101100000 |
| <i>magnicauda</i>     | 1101100000 |
| <i>triangularis</i>   | 1101011000 |
| <i>quadratus</i>      | 1101011100 |
| <i>acanthus</i>       | 1102111211 |
| <i>spatulatus</i>     | 1102011211 |

*brochus* new species, there is a pointed ventral apex but no elongate process.

- 5. Apicolateral region of v-shaped darkening thickened (primitive state: apicolateral region thin).

This state appears in *A. emargilatus* new species, *A. magnicauda* new species and, apparently convergently, in *A. acanthus* new species.

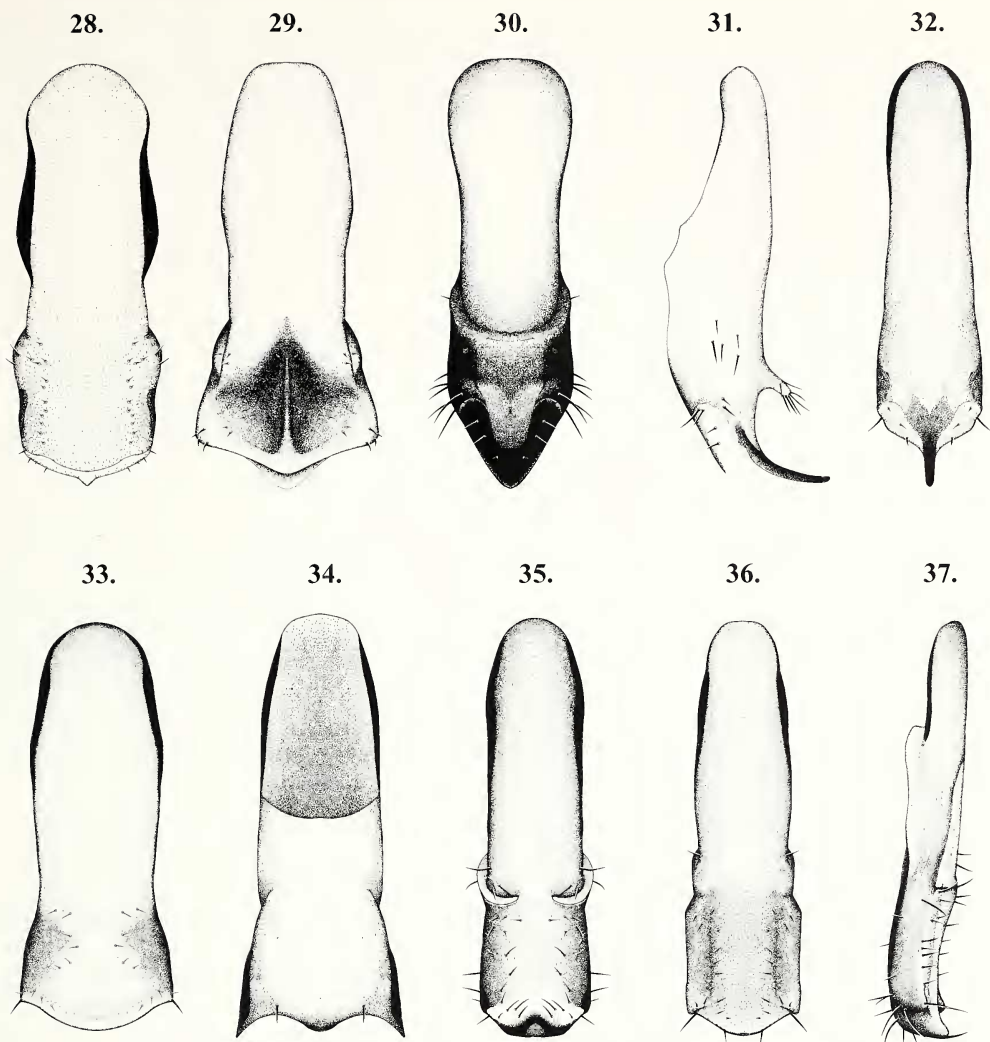
- 6. Median carina present on dorsum of ovipositor (primitive state: carina absent).
- 7. Venter of abdomen densely setose (primitive state: abdominal setation sparser or lacking).
- 8. Median carina with (1) bluntly raised area, (2) sharp spine (primitive state: median carina without differentiated raised area).

The polarization of this character state—and thus the sister group relationship between *A. quadratus* Brown and *A. acanthus* + *A. spatulatus*—is speculative. I assume that the high, sharply pointed spine in *A. acanthus* and *A. spatulatus* was preceded by a lower spine, such as that found in *A. quadratus*.

- 9. Anterior portion of ovipositor darkly sclerotized (anterior portion of ovipositor lightly sclerotized, except for lateral, v-shaped darkening).
- 10. Ovipositor greatly expanded at midlength (Figs. 44–46) (primitive state: ovipositor at most slightly expanded at midlength).
- 11. Anterolateral corner of apical region of ovipositor with dorsal, tooth-like swelling (primitive state: without tooth-like swelling).

The outgroup for this analysis was the *A. paraponerae*-subgroup, plus other *Apocephalus* outside of the *A. attophilus*- and *A. miricauda*-groups. Analysis of these character states with HENNIG-86 resulted in a single tree of length 14, consistency index 92, retention index 95 (Fig. 121).





Figures 28–37. Ovipositors. 28. *Apocephalus incomptus* new species, dorsal. 29. *Apocephalus striativentris* new species, dorsal. 30. *Apocephalus brochus* new species, dorsal. 31. *Apocephalus digitalis* Borgmeier, left lateral. 32. *Apocephalus denotatus* new species, dorsal. Figures 33–34. *Apocephalus pachycondylae* new species. 33. Dorsal. 34. Ventral. 35. *Apocephalus atrimarginatus* new species, dorsal. Figures 36–37. *Apocephalus batillus* new species. 36. Dorsal. 37. Left lateral.

### *Apocephalus incomptus* new species

(Fig. 28)

**SPECIES RECOGNITION.** This relatively plain species can be recognized by the lack of ventral setae and the unmodified ovipositor.

**DESCRIPTION.** Body length 1.5 mm. Frons dark brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow to white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean cos-

tal length 0.5 wing length; range 0.49–0.50. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, yellow medially and anteriorly, tergite 6 yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with seta of medium length at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of small, ventrolateral group and smaller lateral setae. Ovipositor (Fig. 28) straight in lateral view, lightly sclerotized, but with darker apical area. Lateral darkening not differentiated; apical region dark, rectangular. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn

out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 not differentiated but anteriorly encircling segment. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from Amazonian Brazil and Ecuador.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for unadorned, referring to the relatively simple ovipositor.

**HOLOTYPE.** ♀, ECUADOR: Sucumbios: Sacha Lodge, 0.5°N, 76.5°W, 25.vii–3.viii.1994, P. Hibbs, Malaise trap, 270 m [LACM ENT 040968] (LACM).

**PARATYPES.** BRAZIL: Amazonas: Manaus, Reserva Ducke, 3.13°S, 60.02°W, 1♀, 6–17.vii.1992, J. Vidal, Arm. Cola, 1-B-1 m (LACM). ECUADOR: Sucumbios: Sacha Lodge, 0.5°N, 76.5°W, 1♀, 4–14.v.1994, P. Hibbs, Malaise trap, 270 m (LACM).

### *Apocephalus striativentris* new species

(Fig. 29)

**SPECIES RECOGNITION.** This species can be immediately recognized by the darkly sclerotized striations of intersegment 6–7. Other species have these striations (for instance, see Brown, 1992, fig. 35B–D), but they are not black with sclerotization. The dorsum of the ovipositor of this species also has a small, apical ridge (Fig. 29).

**DESCRIPTION.** Body length 1.5–1.8 mm. Frons dark brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus light brown. Dorsum of thorax light brown; pleuron yellow to brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur of even color anteriorly. Mean costal length 0.51 wing length; range 0.49–0.52. Wing vein  $R_{2+3}$  present. Halter light brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 complete, with short setae at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row. Intersegment 6–7 ventrally with darkly sclerotized, longitudinal striations. Ovipositor (Fig. 29) slightly upturned apically, dorsally concave, with a median ridge posteriorly; lightly but evenly sclerotized dorsally. Lateral darkening short, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor a rounded point. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 broad, without anterior process. Dufour's mechanism not seen. Abdominal glands in segment 5

white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from Brazil, Costa Rica, Ecuador, and Peru.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name refers to the darkened, ventral striations of abdominal intersegment 6–7.

**HOLOTYPE.** ♀, ECUADOR: Sucumbios: Sacha Lodge, 0.5°S, 76.5°W, 24.v–3.vi.1994, P. Hibbs, Malaise trap, 270 m [LACM ENT 038105] (LACM).

**PARATYPES.** BRAZIL: Amazonas: Reserva Ducke, 3.13°S, 60.02°W, 4♀, 8–15.iv.1992, J. Vidal, Arm-Cola 1-B-1 m, 1♀ Arm. Oleo 1-A-1 m (INPA, LACM). COSTA RICA: Heredia, La Selva Biological Station, 10.43°N, 84.02°W, 1♀, 2.iii.1993, ALAS, Malaise trap, M/05/20 (INBC); Puntarenas: San Vito, Las Cruces, 8.78°N, 83.0°W, 1♀, iii.1988, P. Hanson, Malaise trap, 1300 m (LACM). ECUADOR: Sucumbios: Sacha Lodge, 0.5°S, 76.5°W, 1♀, 23.iv–3.v.1994, 1♀, 4–14.v.1994, 1♀, 14–24.v.1994, 4♀, 24.v–3.vi.1994, 1♀, 3–16.viii.1994, P. Hibbs, Malaise trap, 270 m (LACM, QCAZ). PERU: Madre de Dios: Zona Reserva Manu, Pakitza, 11.95°S, 71.28°W, 2♀, 7–9.iii.1992, R. Cambra, Malaise trap (LACM, MUSM).

### *Apocephalus brochus* new species

(Fig. 30)

**SPECIES RECOGNITION.** This species is distinctive in the broad, dark, pointed, medial process of the dorsum of the ovipositor (Fig. 30). It is most closely related to *A. fuscipalpis* Borgmeier, based on the shared presence of anterior, tooth-like processes on the ovipositor.

**DESCRIPTION.** Body length 1.4–1.6 mm. Frons yellow to light brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax yellow; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.5 wing length; range 0.47–0.51. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with a few, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 short, consisting of a complete ventral and lateral row. Ovipositor (Fig. 30) slightly upturned apically, lightly but evenly sclerotized dorsally, with anterolateral tooth-like swelling. Lateral darkening convergent to apical point, margin dark, complete. Dorsoapical sclerite



of ovipositor not differentiated. Apicodorsal margin of ovipositor pointed, broad, heavily sclerotized. Apicoventral margin of ovipositor drawn out into point, but without long, filament-like process. Ovipositor without ventral postapical sclerite. Sternite 7 not differentiated but anteriorly encircling segment. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from Brazil and Colombia.

**WAY OF LIFE.** Females of this species attacked healthy *Camponotus banghaasi* Emery and *C. rapax* (Fabricius) that were attracted to tuna fish baits. Flies hovered over the ants and darted at the posterior part of the heads of their hosts.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for projecting, referring to the extended dorsal apex of the ovipositor.

**HOLOTYPE.** ♀, COLOMBIA: Amazonas: 22 km NW Leticia, 4.04°S, 69.99°W, 6.ix.1997, B. Brown, G. Kung, over baited *Camponotus banghaasi* (UNCB) [LACM ENT 102257].

**PARATYPES.** BRAZIL: Pará: Oriximiná, 1.8°S, 53.83°W, 1♀, 13.x.1992, J. Rafael, Malaise trap (INPA). COLOMBIA: 1♀, same locality and collectors as holotype, 28.viii.1997, over baited *Camponotus rapax* (LACM), 21♀, same data as holotype (LACM, MCZC, MZSP, UNCB, USNM).

*Apocephalus fuscipalpis* Borgmeier  
(Fig. 118)

*Apocephalus fuscipalpis* Borgmeier, 1958:325, figs. 9–10, 13.

**HOLOTYPE.** ♀, BRAZIL: Santa Catarina: Nova Teutônia, iv.1950, F. Plaumann [LACM ENT 033880] (MZSP; examined).

**SPECIES RECOGNITION.** This species differs from its closest relative, *A. brochus*, by the less sclerotized and produced dorsal apex of the ovipositor. Female specimens of *A. fuscipalpis* are also significantly larger in size than those of *A. brochus*.

**DESCRIPTION.** Body length 1.8–1.9 mm. Frons light brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair slightly smaller than upper pair. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown. Pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown. Apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.49 wing length (no variation). Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen dark gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with long seta at posterolateral corner. Venter of segments 3–5 with few, medial setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a

complete ventral and lateral row. Ovipositor straight in lateral view, lightly but evenly sclerotized dorsally, with anterolateral tooth-like swelling (Fig. 118). Lateral darkening not differentiated. Dorsal apical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor pointed. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Ovipositor without separate sclerites laterally. Sternite 7 not differentiated but anteriorly encircling segment. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in southeastern Brazil.

**WAY OF LIFE.** Unknown.

**OTHER MATERIAL EXAMINED.** 1♀ paratype, BRAZIL: Santa Catarina: Nova Teutônia, ix.1958, F. Plaumann (MZSP).

*Apocephalus digitalis* Borgmeier  
(Fig. 31)

*Apocephalus digitalis* Borgmeier, 1971:101, figs. 138–139.

**HOLOTYPE.** ♀, BRAZIL: Santa Catarina: Nova Teutônia, F. Plaumann [LACM ENT 093873] (MZSP; examined).

**SPECIES RECOGNITION.** This species is extremely close to *A. denotatus* new species, but the holotype of *A. digitalis* has a distinctive dorsal process on the ovipositor that is lacking in *A. denotatus*. Both have extremely lightly sclerotized ovipositors, except for the heavily sclerotized, prominent, dorsal process.

**DESCRIPTION.** Body length 1.5 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.54 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites yellow, posteriorly dark brown; tergite 6 completely yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with a few, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 31) upturned apically, lightly but evenly sclerotized dorsally; with medial, setose process. Lateral darkening short, margin dark, complete. Dorsal apical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor pointed, greatly elongate. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 not differen-

tiated. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite small, round.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in southeastern Brazil.

**WAY OF LIFE.** Unknown.

### *Apocephalus denotatus* new species

(Fig. 32)

**SPECIES RECOGNITION.** This species differs from the extremely similar *A. digitalis* by the lack of a dorsomedial process on the ovipositor.

**DESCRIPTION.** Body length 1.3–1.4 mm. Frons light brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.59 wing length; range 0.59–0.60. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, yellowish anteriorly, tergite 6 yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with a pair of large, posterior setae. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 32) slightly upturned apically, lightly but evenly sclerotized dorsally. Lateral darkening not differentiated. Apicodorsal margin of ovipositor pointed, greatly elongate. Apicoventral margin of ovipositor drawn out into pointed process; this process thicker and more rounded than in related species. Ovipositor without ventral postapical sclerite. Sternite 7 not differentiated. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite rounded, with a short process.

**GEOGRAPHICAL DISTRIBUTION.** Known from lowland Costa Rica.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for conspicuous, referring to the large ventromedial projection of the ovipositor.

**HOLOTYPE.** ♀, COSTA RICA: Puntarenas: 3 km SW Rincon, 8.68°N, 83.48°W, iii–v.1989, P. Hanson, Malaise trap, 10 m [LACM ENT 050925] (LACM).

**PARATYPES.** COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 2 ♀, 1–15.iv.1993, ALAS, Malaise trap M/04/67, M/15/78 (INBC); Puntarenas: 23 km NW Puerto Jimenez, 8.67°N, 83.45°W, 1 ♀, i–iv.1991, P. Hanson, Malaise trap, 10 m (LACM), 3 km SW Rincon, 8.68°N, 83.48°W, 4 ♀, iii.1989, P. Hanson, Malaise trap, 10 m (LACM, MUCR).

### *Apocephalus pachycondylae* new species

(Figs. 33–34)

**SPECIES RECOGNITION.** This species is somewhat nondescript. It differs from other species with a long, filamentlike, ventral process by the lack of ornamentation of the ovipositor and the distinct lateral darkenings.

**DESCRIPTION.** Body length 1.1–1.5 mm. Frons light brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron light brown to white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.55 wing length; range 0.54–0.56. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with a pair of large, posterior setae. Venter of segments 3–5 with few, medial setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 33–34) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening short, ill-defined, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 broad, lightly sclerotized. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from one site each in Panama and Costa Rica.

**WAY OF LIFE.** Most specimens were collected over a raid of army ants, *Eciton lucanoides*. The army ants were raiding *Pachycondyla obscuricornis* (Emery), among others; at one point I observed the flies circling around army ants that were trying to pry open a hole on a tree trunk. One specimen was attracted to an injured worker of *P. apicalis*.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on that of the presumed hosts, species of the ant genus *Pachycondyla* (F. Smith).

**HOLOTYPE.** ♀, COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 3.vii.1993, B. Brown, over raid *Eciton lucanoides* [LACM ENT 012797] (LACM).

**PARATYPES.** COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 1 ♀, 24.vi.1993, B. Brown, injured *Pachycondyla apicalis* (LACM), 1 ♂, 7 ♀, same data as holotype (male collected *in copula* with one of the females) (INBC, LACM, MUCR). PANAMA: San Blas: Nusagandi Reserve, 9.33°N, 79°W, 1 ♀, 16–



23.iv.1994, J. Pickering, Malaise trap #2862 (LACM).

*Apocephalus atrimarginatus* new species  
(Fig. 35)

**SPECIES RECOGNITION.** This species is similar to *A. batillus* new species but has an ovipositor with a much darker posterior margin.

**DESCRIPTION.** Body length 1.4–1.8 mm. Frons light brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.52 wing length; range 0.50–0.55. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with long seta at posterolateral corner. Venter of segments 3–5 with few, medial setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 35) slightly upturned apically, lightly sclerotized, but with darker apical area. Lateral darkening not differentiated; apical region dark, especially posterior margin. Apicodorsal margin of ovipositor sinuous. Apicoventral margin of ovipositor drawn out into extremely long, pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 not differentiated but anteriorly encircling segment. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite small, oval.

**GEOGRAPHICAL DISTRIBUTION.** Known from a few sites on the Osa Peninsula in Costa Rica.

**WAY OF LIFE.** Females were attracted to injured workers of *Pachycondyla unidentata*. One was attracted to an injured *Odontomachus laticeps* Roger, but it was collected at the same time as another anomalous species for this host, *A. comosus* new species. It is possible that there was some contamination from fluids of other ants that I was crushing on this day. One was also attracted to an injured *Odontomachus bauri* Emery.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on Latin words for black and margin, referring to the darkened posterodorsal margin of the ovipositor.

**HOLOTYPE.** ♀, COSTA RICA: Puntarenas: 5 km SW Rincon, 8.7°N, 83.51°W, 6.vi.1998, B. Brown, injured *Pachycondyla unidentata* [LACM ENT 116694] (LACM).

**PARATYPES.** COSTA RICA: Puntarenas: Coopemarti, 8.63°N, 83.47°W, 1 ♀, ii.1991, P. Hanson,

Malaise trap (LACM), 3 km SW Rincon, 8.68°N, 83.48°W, 1 ♀, vi–viii.1989, 1 ♀, x–xii.1990, 2 ♀, x.1991, P. Hanson, Malaise trap (LACM, MUCR), 5 km SW Rincon, 8.7°N, 83.51°W, 1 ♀, 3.vi.1998, B. Brown, injured *Odontomachus laticeps* (LACM), 1 ♀, 4.vi.1998, *O. bauri* (LACM), 3 ♀, 5.vi.1998, 2 ♀, 6.vi.1998, B. Brown, injured *Pachycondyla unidentata* (INBC, LACM).

*Apocephalus batillus* new species  
(Figs. 36–37)

**SPECIES RECOGNITION.** This species most closely resembles *A. atrimarginatus* but has a less darkened posterior margin of the ovipositor. Females of *A. incomptus* (Fig. 28) are somewhat similar but lack the long, filament-like process on the ventral apex of the ovipositor.

**DESCRIPTION.** Body length 1.0–1.8 mm. Frons light brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.51 wing length; range 0.49–0.53. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, yellow medially and anteriorly, tergite 6 yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with long seta at posterolateral corner. Venter of segments 3–5 with few, medial setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 36–37) slightly upturned apically, lightly sclerotized, but with darker apical area. Lateral darkening not differentiated; apical region dark, with small, lateral incision. Apicodorsal margin of ovipositor pointed. Apicoventral margin of ovipositor drawn out into extremely long, thin, pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 not differentiated but anteriorly encircling segment. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

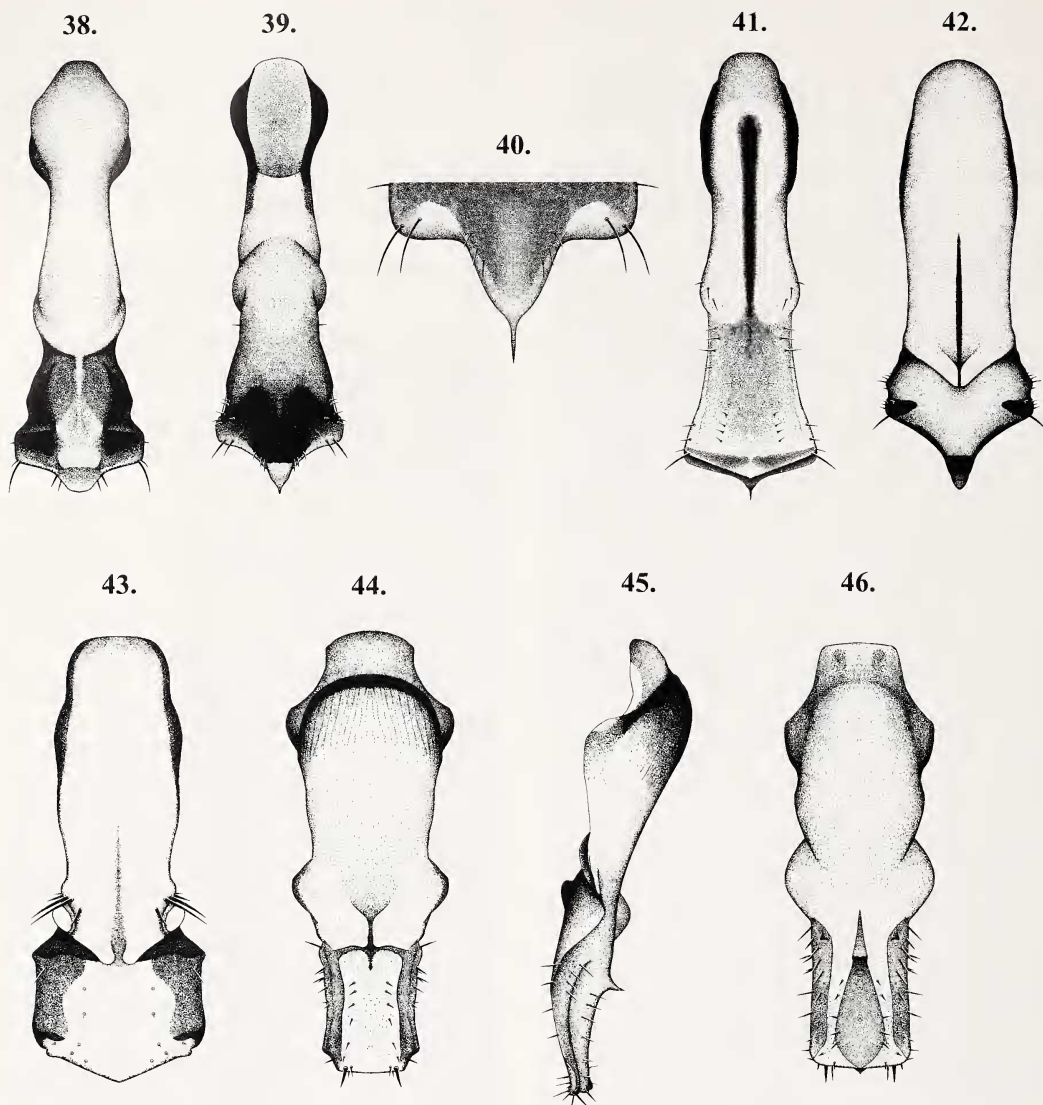
**GEOGRAPHICAL DISTRIBUTION.** Known only from Barro Colorado Island, Panama.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for shovel, referring to the shape of the ovipositor.

**HOLOTYPE.** ♀, PANAMA: Canal Zone: Barro Colorado Island, 9.15°N, 79.85°W, 10–17.iii.1993, J. Pickering, Malaise trap #957 [LACM ENT 094017] (LACM).

**PARATYPES.** PANAMA: Canal Zone: Barro Colorado Island, 9.15°N, 79.85°W, 1 ♀, 13–20.i.1993, Malaise trap, 3 ♀, 20–27.i.1993, Mal-



Figures 38–46. Ovipositors. Figures 38–40. *Apocephalus emargilatus* new species. 38. Dorsal. 39. Ventral. 40. Tip of ovipositor, ventral. 41. *Apocephalus magnicauda* new species, dorsal. 42. *Apocephalus triangularis* new species, dorsal. 43. *Apocephalus quadratus* Brown, dorsal. Figures 44–45. *Apocephalus acanthus* new species. 44. Dorsal. 45. Left lateral. 46. *Apocephalus spatulatus* Borgmeier, dorsal.

aise trap #736, 2♀, 24–31.iii.1993, Malaise trap, #959, 1♀, 4–11.viii.1993, Malaise trap #1670, 1♀, 6–13.iv.1994, Malaise trap #2419, 4♀, 20–27.iv.1994, Malaise trap #2421, J. Pickering (LACM, MCZC, MIUP, MZSP, USNM).

*Apocephalus emargilatus* new species  
(Figs. 38–40)

**SPECIES RECOGNITION.** This species can be recognized by the expanded proximal portion of the ovipositor and lateral emargination of the apical portion of the ovipositor.

**DESCRIPTION.** Body length 1.3–1.8 mm. Frons

yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair slightly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron white to light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur of even color anteriorly. Mean costal length 0.5 wing length; range 0.49–0.51. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, yellow medially and anteriorly, tergite 6 yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite



3 evenly colored. Tergite 6 anteriorly and posteriorly emarginate, with long seta at posterolateral corner. Venter of segments 3–5 with few, medial setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row; lateral setae much shorter. Ovipositor (Figs. 38–39) slightly upturned apically, lightly sclerotized, but with darker apical area. Lateral darkening not differentiated; apical region dark, with transverse ridges and laterally emarginate. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn out into pointed process (Fig. 40). Ovipositor without ventral postapical sclerite. Sternite 7 not differentiated but anteriorly encircling segment. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from two sites on the Osa Peninsula in Costa Rica.

**WAY OF LIFE.** One specimen was attracted to an injured worker of *Camponotus sericeiventris* (Guérin-Ménéville).

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the lateral emargination of ovipositor.

**HOLOTYPE.** ♀, COSTA RICA: Puntarenas: Sirena, 8.48°N, 83.6°W, 1♀, 11.vii.1993, D. Feener, injured *Camponotus sericeiventris* [LACM ENT 024158] (LACM).

**PARATYPES.** COSTA RICA: Puntarenas, 3♀, Coopemarti, 8.63°N, 83.47°W, ii.1991, P. Hanson, Malaise trap (LACM).

### *Apocephalus magnicauda* new species

(Fig. 41)

**SPECIES RECOGNITION.** The ovipositor of this species is apically expanded, without lateral emarginations; otherwise it is similar to *A. emargilatus*.

**DESCRIPTION.** Body length 1.7–2.1 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron yellow to white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.52 wing length; range 0.51–0.53. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, yellow medially and anteriorly, tergite 6 yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly and posteriorly emarginate, with setae of medium length along posterior margin. Venter of segments 3–5 with few, medial setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row; lateral setae slender. Ovipositor

(Fig. 41) slightly upturned apically, lightly sclerotized, but with darker apical area. Lateral darkening not differentiated; apical region dark, posteriorly expanded. Apicodorsal margin of ovipositor pointed. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 not differentiated but anteriorly encircling segment. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from Amazonian Ecuador and Peru.

**WAY OF LIFE.** I collected two females that were flying above *Camponotus sericeiventris* attracted to a tuna fish bait. The ants were agitated, running around in a seeming panic response.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word *magnus*, for large, referring to the apically enlarged ovipositor.

**HOLOTYPE.** ♀, ECUADOR: Sucumbios: Sacha Lodge, 0.5°N, 76.5°W, 3–13.vi.1994, P. Hibbs, Malaise trap, 270 m [LACM ENT 027779] (LACM).

**PARATYPES.** ECUADOR: Sucumbios: Sacha Lodge, 0.5°N, 76.5°W, 2♀, 22.ii–4.iii.1994, 1♀, 13–23.iv.1994, 1♀, 13–25.vii.1994, P. Hibbs, Malaise trap, 270 m (LACM, QCAZ). PERU: Madre de Dios: Zona Reserva Manu, Pakitza, 11.95°S, 71.28°W, 2♀, 25.ii.1992, B. Brown, D. Feener, over baited *Camponotus sericeiventris* (LACM, MUSM).

### *Apocephalus triangularis* new species

(Fig. 42)

*Apocephalus fuscipalpis* Borgmeier, 1958:325, figs. 9–10, 13 (in part).

**SPECIES RECOGNITION.** This species is easily recognized by the triangular apex of the ovipositor and its distinctive dark markings and by the prominent, medial ridge.

Specimens of this species were among Borgmeier's paratypes of *A. fuscipalpis*.

**DESCRIPTION.** Body length 1.8 mm. Frons light brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.46 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, yellow medially and anteriorly, tergite 6 yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with three long setae on posterior margin of each sclerite. Venter of segments 3–5 with small, dense setae medially. Abdomen without dense lateral setae.

Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 42) slightly upturned apically, lightly sclerotized, but with darker apical area and prominent, medial ridge. Lateral darkening not differentiated; much of apical region dark, triangular with lateral, darker patches. Apicodorsal margin of ovipositor pointed. Apicoventral margin of ovipositor drawn out into pointed process; process extremely long and heavily sclerotized. Ovipositor without ventral postapical sclerite. Sternite 7 not differentiated but anteriorly encircling segment. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known only from Brazil and Mexico.

**WAY OF LIFE.** Unknown.

**HOLOTYPE.** ♀, MEXICO: Chiapas: Montebello, vii.1969, W. Mason, Malaise trap (LACM).

**PARATYPE.** BRAZIL: Nova Teutônia, 1 ♀, xi.1958, F. Plaumann (MCZC).

*Apocephalus quadratus* Brown  
(Fig. 43)

*Apocephalus quadratus* Brown, 1997b:47–48, fig. 67.

**HOLOTYPE.** ♀, ECUADOR: Sucumbios: Sacha Lodge, 0.5°S, 76.5°W, 12–22.ii.1994, P. Hibbs, Malaise trap, 270 m [LACM ENT 006850] (LACM; examined).

**SPECIES RECOGNITION.** This species has an extremely distinctive ovipositor, with a broad apical region and with large, dark, heavily sculpted lateral darkenings. There is a medial ridge with a low prominence or spine at midlength.

I considered this a species of the *A. attophilus*-group (Brown, 1997b) before my more precise definition of the *A. miricauda*-group was formulated.

**DESCRIPTION.** See Brown, 1997b.

**GEOGRAPHICAL DISTRIBUTION.** Ecuador, Brazil.

**WAY OF LIFE.** Unknown.

**NEW MATERIAL EXAMINED.** BRAZIL: Minas Gerais: Belo Horizonte, Estação Ecológica, UFMG campus, 1 ♀, 12–15.vii.1993, S. Gaimari, Malaise trap, 800 m (BHMH).

*Apocephalus acanthus* new species  
(Figs. 44–45)

**SPECIES RECOGNITION.** This species, like *A. spatulatus*, has an ovipositor with a dorsal spine and distinctive lateral darkenings. The ovipositor of *A. acanthus* differs in many small ways, however, the most easily qualified being in the apex of the ovipositor, which is obliquely truncate.

**DESCRIPTION.** Body length 1.4 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow to

light brown. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.5 wing length; range 0.49–0.50. Wing vein  $R_{2+3}$  present. Halter mostly yellow, but with dark brown spot on knob. Abdominal tergites dark brown, yellow medially and anteriorly, tergite 6 yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with a pair of large, posterior setae. Venter of segments 3–5 with small, dense setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row, but lateral setae shorter. Ovipositor (Figs. 44–45) slightly upturned apically, lightly sclerotized, but with darker apical area; dorsally with medial spine. Lateral darkening thin, subparallel, margin dark, complete. Dorsal apical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight, laterally with oblique truncation. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 not differentiated but anteriorly encircling segment. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from two lowland sites in Costa Rica.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is from a Greek word for spine, referring to the mid-dorsal spine of the ovipositor.

**HOLOTYPE.** COSTA RICA: Puntarenas: 3 km SW Rincon, 8.68°N, 83.48°W, viii.1991, P. Hanson, Malaise trap, 10 m [LACM ENT 048759] (LACM).

**PARATYPE.** COSTA RICA: Guanacaste: Al Taboga Forest Reserve, 9 km SW Cañas, 1 ♀, 17–27.ii.1987, W.L. Rubink, Malaise trap (EMUS).

*Apocephalus spatulatus* Borgmeier  
(Fig. 46)

*Apocephalus spatulatus* Borgmeier, 1958:322, figs. 7, 12.

**HOLOTYPE.** ♀, BRAZIL: Santa Catarina: Nova Teutônia, F. Plaumann [LACM ENT 061158] (MZSP; examined).

**SPECIES RECOGNITION.** This species, like the preceding one, has a distinctive dorsal spine on the ovipositor. Unlike *A. acanthus*, however, *A. spatulatus* has the posterior corners of the apex of the ovipositor squared, not obliquely truncate (Fig. 46).

**DESCRIPTION.** The single specimen of this species apparently was air-dried and has not retained its natural color. Some references to color were therefore made by referring to the original description.

Body length 1.8 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal



setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax yellow; pleuron yellow. Anterior scutellar seta small, fine, slightly larger than posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.45 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, yellow medially and anteriorly, tergite 6 yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with several long setae on posterior margin. Venter of segments 3–5 with small, dense setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 46) slightly upturned apically, with dark anterior and lighter posterior sclerotization; dorsally with medial spine. Lateral darkening thin, subparallel, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 not differentiated but anteriorly encircling segment. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in Brazil.

**WAY OF LIFE.** Unknown.

### *Apocephalus miricauda*-subgroup

**DIAGNOSIS.** Ovipositor strongly bent dorsally at midlength.

**PHYLOGENETIC RELATIONSHIPS.** Unknown.

**WAY OF LIFE.** Two species are known to attack injured ants of the genus *Dinoponera* Roger. The other two species, *A. flexus* and *A. orbiculus*, occur outside the published distribution of *Dinoponera* species (Kempf, 1971) and must use different hosts.

### *Apocephalus miricauda* Borgmeier

(Figs. 47–49)

*Apocephalus miricauda* Borgmeier 1971:111; figs. 150–152.

**HOLOTYPE.** ♀, BRAZIL: Pará: Utinga, xii.1966, S.J. de Oliveira (MZSP; examined).

**SPECIES RECOGNITION.** This species can be recognized by the curved ovipositor in lateral view (Fig. 49) and the extremely expanded sternite 7, which is visible projecting laterally from above (Fig. 47).

**DESCRIPTION.** Body length 2.4–2.9 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow.

Dorsum of thorax yellow; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellow; apex of hind femur of even color anteriorly. Mean costal length 0.54 wing length; range 0.53–0.55. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, lighter medially. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly and posteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3–5 with a few, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 short, consisting of single median pair. Ovipositor (Figs. 47–49) deflected dorsally posterior to midpoint, with triangular median sclerite. Lateral darkening posteriorly enlarged, truncate, margin dark, complete. Dorsoapical sclerite of ovipositor triangular. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 triangular, apically flared with small lateral projections. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite a simple, round loop.

**GEOGRAPHICAL DISTRIBUTION.** Known only from Brazil. The host ant is known from Brazil and Peru (Kempf, 1971).

**WAY OF LIFE.** The life history of this species was described by Silveira-Costa and Moutinho (1996), who found that it was attracted to injured workers of *Dinoponera gigantea* (Perty).

**PHYLOGENETIC RELATIONSHIPS.** This species and *A. kungae* new species are hypothesized to be sister-species, based on the enlarged, broadened sternite 7 with particularly distinct fringes of lateral processes.

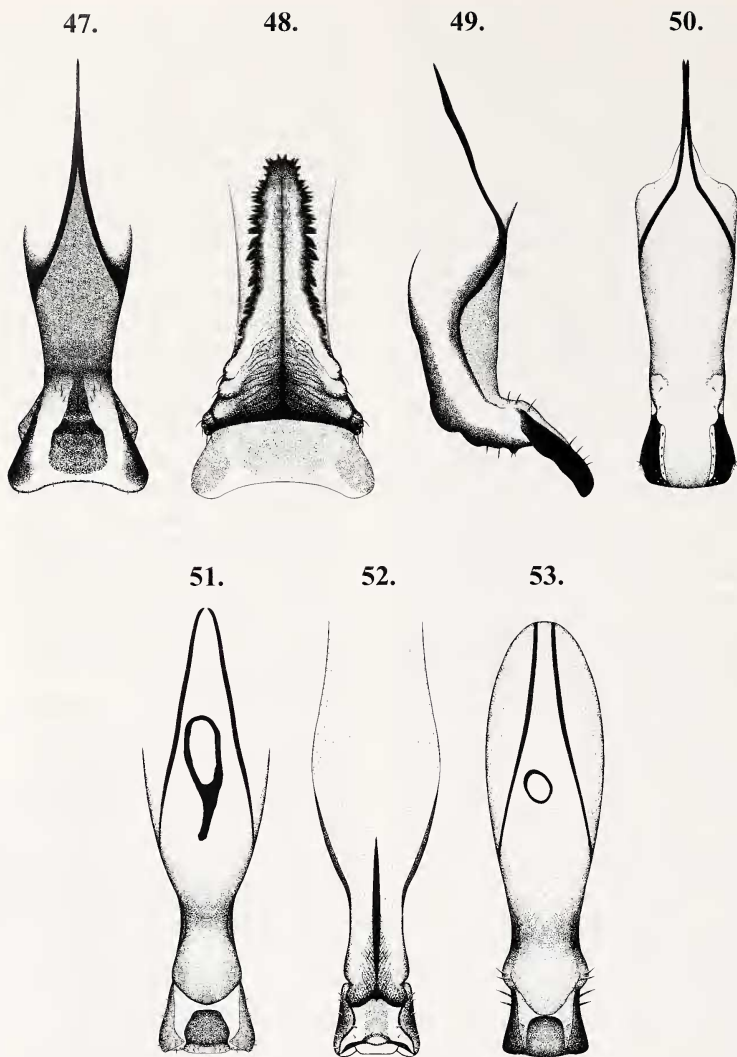
**MATERIAL EXAMINED.** BRAZIL: Pará: Paragominas, 2.92°S, 47.58°W, 1♀, v.1994, 3♀, 10.v.1995, A. Silveira-Costa, injured *Dinoponera gigantea* (LACM).

### *Apocephalus kungae* new species

(Figs. 50, 108)

**SPECIES RECOGNITION.** This species differs from the others in this group by the extremely broad area of medium sclerotization between the lateral darkenings of the ovipositor (Fig. 50). It is similar in many respects to *A. dinoponerae* new species, with which it was collected, but *A. dinoponerae* does not have a dorsally flexed ovipositor and its sternite 7 is of a different form.

**DESCRIPTION.** Body length 1.9 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white to light brown. Anterior scutellar seta large, bristle-like. Legs yellowish-brown; apex of hind femur with abrupt, but small, darkening on anterior face. Mean costal length 0.56 wing length. Wing vein



Figures 47-53. Ovipositors. Figures 47-49. *Apocephalus miricauda* Borgmeier. 47. Dorsal. 48. Ventral. 49. Left lateral. 50. *Apocephalus kungae* new species, dorsal. Figures 51-52. *Apocephalus flexus* new species. 51. Dorsal (showing internal, sclerotized loop). 52. Ventral. 53. *Apocephalus orbiculus* new species, dorsal (showing internal, sclerotized loop).

$R_{2+3}$  present. Halter brown. Abdominal tergites yellowish-brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 6 anteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3-5 with a few, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 50) deflected dorsally at midpoint, lightly but evenly sclerotized dorsally. Lateral darkening apically convergent and lighter in color, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor rounded. Ovipositor without ventral postapical sclerite. Sternite 7 triangular, apically flared with small lateral projec-

tions. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite a simple, round loop (Fig. 108).

**GEOGRAPHICAL DISTRIBUTION.** Known only from southeastern Colombia. The host ant is known from Brazil and Peru (Kempf, 1971).

**WAY OF LIFE.** An injured worker of *Dinoponera longipes* Emery attracted this fly.

**PHYLOGENETIC RELATIONSHIPS.** See *A. miricauda*.

**DERIVATION OF SPECIFIC EPITHET.** This species is named after Ms. Giar-Ann Kung, who helped me study its way of life and collect the holotype.

**HOLOTYPE.** ♀, COLOMBIA: Amazonas: Amacayacu National Park, 3.82°S, 70.26°W,



5.ix.1997, B. Brown, G. Kung, injured *Dinoponera longipes* [LACM ENT 102143] (UNCB).

### *Apocephalus flexus* new species

(Figs. 51–52, 107)

**SPECIES RECOGNITION.** This species is extremely similar to *A. orbiculus* but differs in having a much larger sclerotized loop (compare Figs. 51 and 53).

**DESCRIPTION.** Body length 1.5 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with a pair of large, posterior setae. Venter of segments 3–5 with few, medial setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row. Ovipositor (Figs. 51–52) deflected dorsally posterior to midpoint, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, truncate, margin dark, complete. Dorsoapical sclerite of ovipositor rounded anteriorly. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite rounded, with long process (Fig. 107).

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in western Ecuador.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for bend, referring to the ovipositor, which is curved dorsally in lateral view.

**HOLOTYPE.** ♀, ECUADOR: Pichincha: 17 km E Santo Domingo, Tinalandia, 6–13.v.1987, B. Brown, windows, 710 m [LACM ENT 012773] (LACM).

### *Apocephalus orbiculus* new species

(Fig. 53)

**SPECIES RECOGNITION.** This species is extremely similar to *A. flexus* but has a slightly different preapical sclerite and a much smaller sclerotized loop (compare Figs. 51 and 53).

**DESCRIPTION.** Body length 1.3 mm. Frons light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, oval. Proboscis normal, small. Palpus light brown. Dorsum of thorax light brown; pleuron yellowish brown. Anterior scutellar seta large, bristle-like. Legs yellowish-brown; apex

of hind femur with abrupt darkening on anterior face. Mean costal length 0.44 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, divided, with short setae at posterolateral corner. Venter of segments 3–5 with a few, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 53) deflected dorsally at midpoint, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, truncate, margin dark, complete. Dorsoapical sclerite of ovipositor rectangular. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite small, round.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single lowland site in Costa Rica.

**WAY OF LIFE.** Unknown. Almost all of the Malaise trap captures were from a single site (trap 12).

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for small circle, referring to the sclerotized loop, which is much smaller than that of the similar *A. flexus*.

**HOLOTYPE.** ♀, COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 3.v.1993, ALAS, Malaise trap M/12/91 [INBI-OCRI002273758] (INBC).

**PARATYPES.** COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 1♀, 16.iii.1993, ALAS, Malaise trap M/12/43, 1♀, 2.iv.1993, ALAS, Malaise trap M/12/59, 1♀, 3.v.1993, ALAS, Malaise trap M/12/91, 3♀, 19.v.1993, ALAS, Malaise trap M/12/006, 1♀, 4.iv.1994, ALAS, Malaise trap M/09/387, 1♀, 17.xi.1998, ALAS, light L/08/513 (INBC, LACM).

### *A. meniscus*-subgroup

**DIAGNOSIS.** Dorsomedial preapical sclerite of ovipositor attached to lateral darkenings by distinctive bar of sclerotization; in most species, lateral postapical sclerites present.

**PHYLOGENETIC RELATIONSHIPS.** The relationships within this group are not resolved.

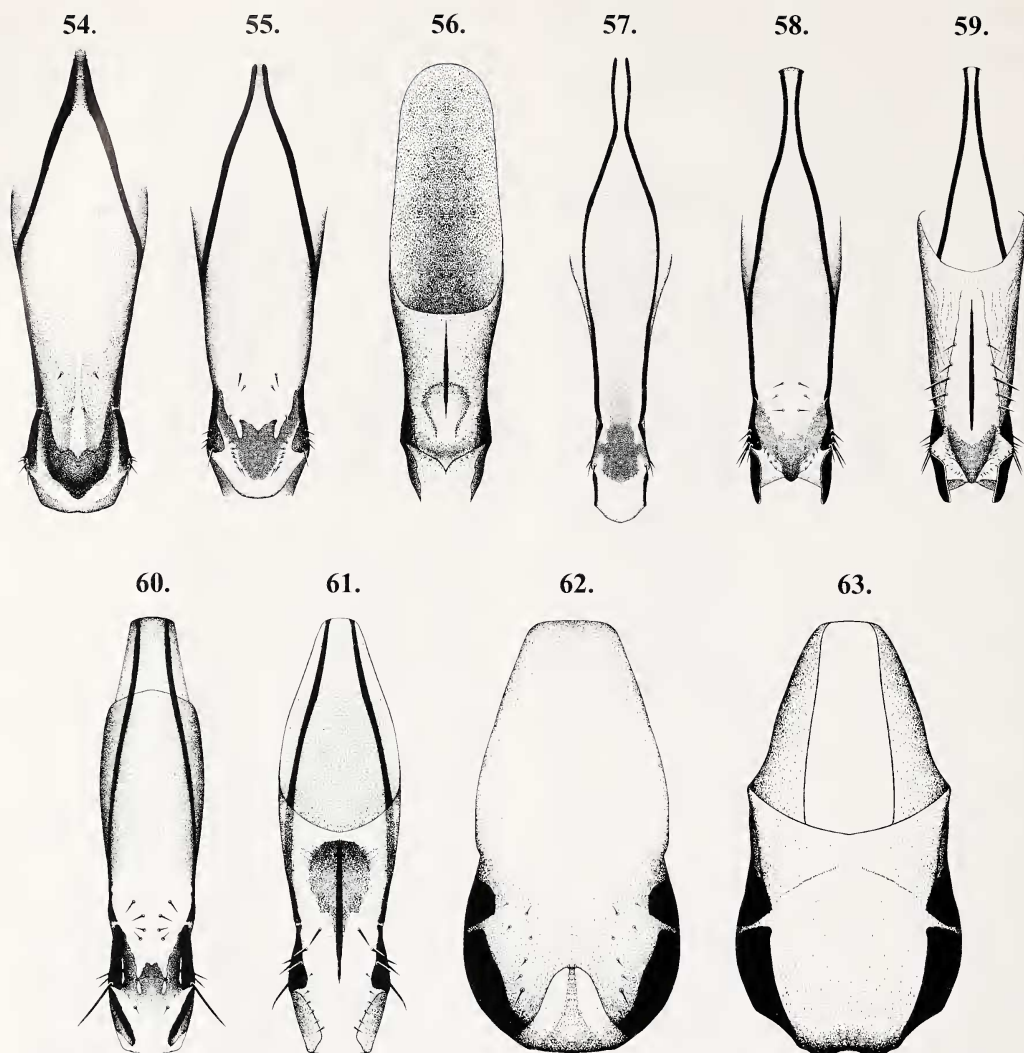
Although it is divergent in structure from all other *A. miricauda*-group species, *A. lopesi* (Borgmeier) clearly belongs in this group. It has the postapical sclerites present but has apparently lost the dorsal preapical sclerite.

**WAY OF LIFE.** The two species with known hosts are parasitoids of injured ants of the genus *Odontomachus* Latreille.

### *Apocephalus meniscus* new species

(Fig. 54)

**SPECIES RECOGNITION.** This species can be recognized by the long, dense ventral setae and the



Figures 54–63. Ovipositors. 54. *Apocephalus meniscus* new species, dorsal. Figures 55–56. *Apocephalus barbiventris* new species. 55. Dorsal. 56. Ventral. 57. *Apocephalus amplidiscus* new species, dorsal. Figures 58–59. *Apocephalus paldiae* new species. 58. Dorsal. 59. Ventral. Figures 60–61. *Apocephalus cyclodiscus* new species. 60. Dorsal. 61. Ventral. Figures 62–63. *Apocephalus lopesi* (Borgmeier). 62. Dorsal. 63. Ventral.

preapical sclerite that does not markedly extend anterior to the lateral bars of sclerotization.

**DESCRIPTION.** Body length 1.1–1.3 mm. Frons yellow to light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.49 wing length; range no range. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with short setae at

posterolateral corner. Venter of segments 3–5 with long, dense setae concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 54) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening thin, subparallel, margin dark, complete. Dorsoapical sclerite of ovipositor trapezoidal. Apicodorsal margin of ovipositor straight. Apicoven-  
tral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known only from Pakitz, Peru.



**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Greek word *meniskos* for crescent, referring to the shape formed by the preapical sclerite and the lateral bars of the ovipositor.

**HOLOTYPE.** ♀, PERU: Madre de Dios, Zona Reserva Manu, Pakitza, 11.95°S, 71.28°W, 13–18.ii.1992, B. Brown, D. Feener, Malaise trap #1 [LACM ENT 012211] (MUSM).

**PARATYPE.** 1♀, same data as holotype (LACM).

### *Apocephalus barbiventris* new species

(Figs. 55–56)

**SPECIES RECOGNITION.** This species is also densely setose ventrally, similar to *A. meniscus*, but has a preapical sclerite that is shaped differently, projecting farther anteriorly on the ovipositor. It also has lateral postapical sclerites, which are lacking in *A. meniscus*.

**DESCRIPTION.** Body length 1.2–1.4 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax yellow; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum (slightly larger). Legs yellowish-brown; apex of hind femur slightly darker on anterior face. Mean costal length 0.48 wing length; range 0.47–0.5. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3–5 with long, dense setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 55–56) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, truncate, margin dark, complete. Dorsal apical sclerite of ovipositor rectangular, anteriorly emarginate; with lateral bars extended to anterior apex of lateral darkenings. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 thin, with lighter, expanded area at midlength. Dufour's mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a few sites on the Osa Peninsula in Costa Rica.

**WAY OF LIFE.** One female was attracted to injured *Odontomachus bauri*.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin words *barba* and *ven-*

*tris*, for beard and belly, referring to the setose venter of the abdomen.

**HOLOTYPE.** ♀, COSTA RICA: Puntarenas: 24 km W Piedras Blancas, 8.77°N, 83.4°W, ii.1992, P. Hanson, Malaise trap, 200 m [LACM ENT 012698] (LACM).

**PARATYPES.** COSTA RICA: Puntarenas: 10 km W Piedras Blancas, 8.75°N, 83.3°W, 2♀, iii–v.1989, P. Hanson, Malaise trap (INBC, LACM), 24 km W Piedras Blancas, 8.77°N, 83.4°W, 1♀, ii.1992, P. Hanson, Malaise trap, 200 m (LACM), 3 km SW Rincon, 8.68°N, 83.48°W, 1♀, ii–iii.1989, 1♀, iii.1989, 1♀, iii–iv.1991, P. Hanson, Malaise trap, 10 m (LACM, MUCR), 5 km SW Rincon, 8.7°N, 83.51°W, 1♀, 4.vi.1998, B. Brown, injured *Odontomachus bauri* (LACM).

### *Apocephalus amplidiscus* new species

(Fig. 57)

**SPECIES RECOGNITION.** This species has a distinctive large preapical sclerite that fills most of the space between the lateral darkenings.

**DESCRIPTION.** Body length 1.4 mm. Frons light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.48 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with long, dense setae concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 57) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening thin, subparallel, margin dark, with separate apical sclerite. Dorsal apical sclerite of ovipositor large, round, dark, shiny. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Dufour's mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite rounded, small, with a short process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single lowland site in Costa Rica.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin words *amplus* and *discus*, for large and plate, referring to the large preapical sclerite of this species.

**HOLOTYPE.** ♀, COSTA RICA: Limon: 7 km SW Bribri, 9.58°N, 82.88°W, xii.1989–ii.1990, P.

Hanson, Malaise trap, 50 m [LACM ENT 047431] (LACM).

*Apocephalus paldiae* new species

(Figs. 58–59)

**SPECIES RECOGNITION.** This species is similar to *A. barbiiventris*, but the ventral setae of the abdomen are much shorter and fewer.

**DESCRIPTION.** Body length 1.3–1.9 mm. Frons yellow to light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 basally yellow, apically brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax yellow; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length; range 0.45–0.51. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3–5 with short setae, concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 58–59) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, truncate, margin dark, with separate apical sclerite. Dorsal apical sclerite of ovipositor heart-shaped; with lateral bars extended to anterior apex of lateral darkenings. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 triangular. Dufour's mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in northern Costa Rica.

**WAY OF LIFE.** These flies are attracted to, and oviposit in, injured workers of *Odontomachus chelifer* (Latreille). Pairs of flies arrive in copula, but the male immediately departs when they land near an injured ant. Both egg-layers and feeders were observed in this species. A single egg ( $n = 6$ ), or in one instance two eggs, are laid in the abdomen, and newly hatched larvae apparently migrate internally through the ant's body to the head, where feeding takes place. Larval feeding ended after  $\bar{x} = 4.75$  days ( $n = 4: 4, 3, 6, 6$  days).

**DERIVATION OF SPECIFIC EPITHET.** This species is named after Ms. Jill Paldi, who helped me study its way of life and collect the type series.

**HOLOTYPE.** ♀, COSTA RICA: Guanacaste: Estación Pitilla, 11.0°N, 85.43°W, 5.vii.1997, J. Paldi, injured *Odontomachus chelifer* [LACM ENT 101744] (LACM).

**PARATYPES.** COSTA RICA: Guanacaste: Estación Biología Pitilla, 11.0°N, 85.43°W, 2♀,

3.vii.1997, 1♂, 13♀, 4.vii.1997, 9♀, 5.vii.1997, B. Brown, J. Paldi, injured *Odontomachus chelifer* (INBC, LACM, MCZC, MUCR, USNM).

*Apocephalus cyclodiscus* new species

(Figs. 60–61)

**SPECIES RECOGNITION.** This species has a distinctive ventral sclerite on segment 7, being expanded and rounded anteriorly, then narrowed posteriorly (Fig. 61).

**DESCRIPTION.** Body length 1.2–1.4 mm. Frons light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow to white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.46 wing length; range 0.45–0.47. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with long seta at posterolateral corner. Venter of segments 3–5 with a few, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row. Ovipositor (Figs. 60–61) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening thin, subparallel, apically divergent, margin dark, with separate apical sclerite. Dorsal apical sclerite of ovipositor rectangular, anteriorly emarginate; with lateral bars extended to anterior apex of lateral darkenings. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 anteriorly rounded, dark; posteriorly narrow. Dufour's mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process.

**GEOGRAPHICAL DISTRIBUTION.** Known from two sites in Panama.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on two Latin words, *cyclos* for round and *discus* for plate, referring to the shape of sternite 7.

**HOLOTYPE.** ♀, PANAMA: San Blas: Nusagandi Reserve, 9.33°N, 79.0°W, 16–23.iv.1994, J. Pickering, Malaise trap #2862 [LACM ENT 101530] (LACM).

**PARATYPES.** PANAMA: Canal Zone: Barro Colorado Island, 9.17°N, 79.83°W, 1♀, 17–24.ii.1993, 1♀, 24–31.iii.1993, J. Pickering, Malaise trap #740, #959 (LACM); San Blas: Nusagandi Reserve, 9.33°N, 79.0°W, 1♀, 5–12.ii.1994, J. Pickering, Malaise trap #2042 (MIUP).



*Apocephalus lopesi* (Borgmeier)

(Figs. 62–63, 104)

*Anaclinus lopesi* Borgmeier, 1969:64–65, figs. 35–37; 1971:5–6, fig. 6, new combination.

**HOLOTYPE.** ♀, BRAZIL: Pará: Belém, vii.1965, H.S. Lopes (MZSP; examined).

**SPECIES RECOGNITION.** This species is extremely distinctive, with the reclinate supra-antennal setae on the unusually modified frons (in both sexes) and the characteristic broad ovipositor. It was previously considered to belong in a separate genus.

**DESCRIPTION.** Body length 1.5 mm. Frons yellow, anterior margin produced between antennae (Fig. 104). One pair of divergent, reclinate supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with long seta at posterolateral corner. Venter of segments 3–5 with long, dense setae concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 62–63) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly narrowed, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor wedge-shaped, posteriorly widened. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 round. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from lowland sites in Brazil, Colombia, Costa Rica, and Guyana.

**WAY OF LIFE.** Females were attracted to crushed workers of *Odontomachus haematodus* (Linnaeus), the presumed host, in Colombia and Guyana. This ant, whose taxonomic history is particularly convoluted (Brown, 1976), apparently occurs only in Amazonian South America. Therefore, *A. lopesi* must attack another host in Costa Rica.

**MATERIAL EXAMINED.** BRAZIL: Pará: Utin-ga, near Belém, 1♂, 1♀, xii.1966, Malaise trap, S.J. de Oliveira (MZSP). COLOMBIA: Amazonas: Amacayacu National Park, 3.82°S, 70.26°W, 1♀, 4.ix.1997, B. Brown, G. Kung, injured *Odontomachus haematodus* (LACM). COSTA RICA: Limon: 16 km W Guapiles, 10.15°N, 83.92°W, 1♀, ii.1989, P. Hanson, Malaise trap, 400 m (LACM); Puntarenas: Cerro Rincon, 8.52°N, 83.47°W, 1♀,

iii.1991, P. Hanson, Malaise trap, 745 m [LACM ENT 017042] (LACM). GUYANA: Berbice: Dubulay Ranch, 5.68°N, 57.86°W, 3♂, 17–22.i.1999, B. Brown, M. Sharkey, Malaise trap #10, #12, #14 (LACM), 4♀, 18.i.1999, B. Brown, injured *O. haematodus* (LACM, UGGG).

*Apocephalus funditus*-subgroup

**DIAGNOSIS.** Setation of dorsum of abdomen short, bristle-like. Ovipositor unusually darkly sclerotized throughout; strongly downturned at midlength.

**PHYLOGENETIC RELATIONSHIPS.** All three of the diagnostic characters are potential synapomorphies of a clade including these two species.

*Apocephalus funditus* new species

(Fig. 64–65)

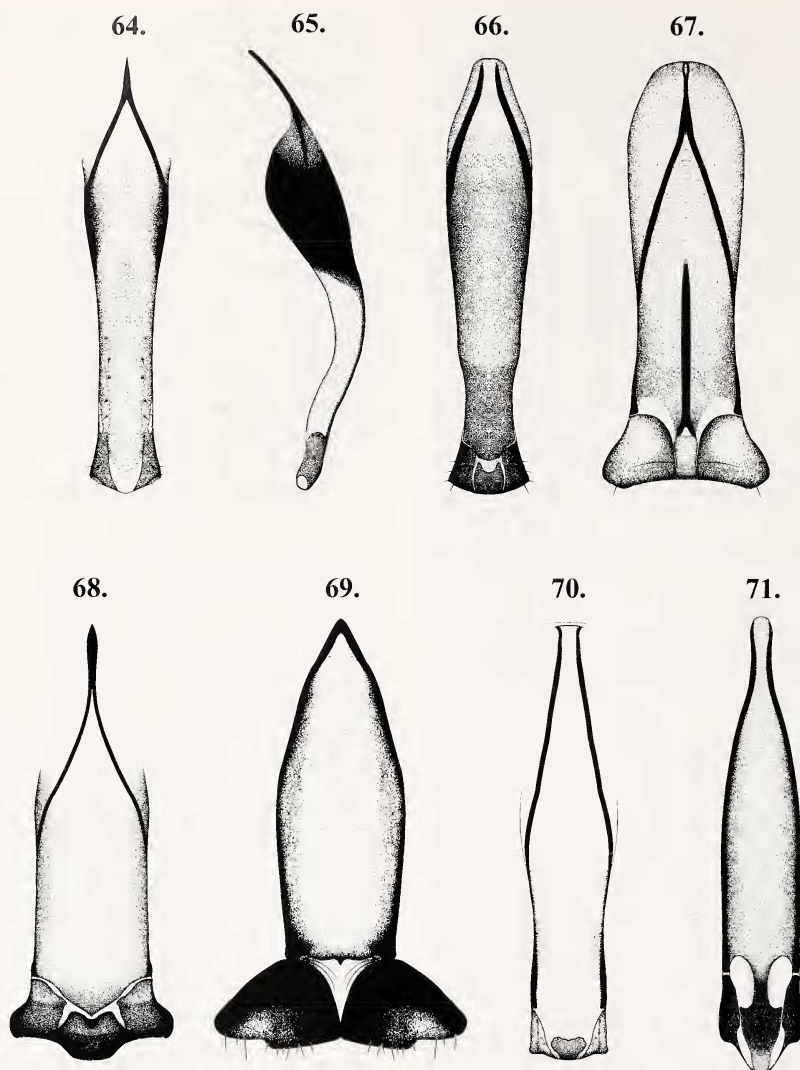
**SPECIES RECOGNITION.** This species has extensive sclerotization, with all sclerotized portions of the ovipositor appearing shiny, dark brown. Unlike *A. intonsus* new species, it lacks a separate preapical sclerite.

**DESCRIPTION.** Body length 1.4–1.6 mm. Frons yellow to light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow to light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur slightly darker on anterior face. Mean costal length 0.44 wing length; range 0.4–0.46. Wing vein  $R_{2+3}$  present. Halter light brown to brown. Abdominal tergites dark brown (yellowish brown in one Costa Rican specimen). Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 65) deflected ventrally at midpoint, darkly sclerotized, with sclerotization extended completely to posterior apex. Lateral darkening posteriorly enlarged, inner margin extended medially, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor rounded. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 broad, narrowed apically but widened abruptly at apex. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process.

**GEOGRAPHICAL DISTRIBUTION.** Known from Brazil, Costa Rica, Ecuador, and Peru.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for complete or wholly, re-



Figures 64–71. Ovipositors. Figures 64–65. *Apocephalus funditus* new species. 64. Dorsal. 65. Left lateral. 66. *Apocephalus intonsus* new species, dorsal. 67. *Apocephalus spatulicauda* Borgmeier, dorsal. 68. *Apocephalus inimicus* Borgmeier, dorsal. 69. *Apocephalus brevifrons* new species, dorsal. 70. *Apocephalus densepilosus* Borgmeier, dorsal. 71. *Apocephalus comosus* new species, dorsal.

ferring to the extensive, dark sclerotization of the ovipositor.

**HOLOTYPE.** ♀, COSTA RICA: Puntarenas: 24 km W Piedras Blancas, 8.77°N, 83.4°W, ii.1992, P. Hanson, Malaise trap, 200 m [LACM ENT 012697] (LACM).

**PARATYPES.** BRAZIL: Roraima: Ilha de Maracá, 3.37°N, 61.43°W, 5 ♀, 2–13.v.1987, J. Rafael, Malaise trap (INPA, LACM). COSTA RICA: 1 ♀, same data as holotype. ECUADOR: Sucumbios: Sacha Lodge, 0.5°S, 76.5°W, 1 ♀, 12–22.ii.1994, 1 ♀, 24.iii–3.iv.1994, 2 ♀, 21–31.x.1994, P. Hibbs, Malaise trap, 270 m (LACM, QCAZ). PERU: Madre de Dios, Zona Reserva Manu, Pakitza, 11.95°S, 71.28°W, 1 ♀, 7–9.iii.1992, R. Cambra, Malaise trap (LACM).

### *Apocephalus intonsus* new species (Figs. 66)

**SPECIES RECOGNITION.** The similarities of this species to *A. funditus* are discussed above. It is also similar to *A. indistinctus* new species, except that the ovipositor is downturned sharply at mid-length.

**DESCRIPTION.** Body length 1.1–1.3 mm. Frons light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with



abrupt darkening on anterior face. Mean costal length 0.44 wing length; range 0.42–0.45. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, with short, bristly setae. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3–5 with few, medial setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 66) deflected ventrally at midpoint, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, inner margin extended medially (slightly), margin dark, complete. Dorsoapical sclerite of ovipositor rectangular, anteriorly emarginate. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 broadly, evenly developed across entire venter of ovipositor. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in Panama.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for unshaven referring to the short, bristly setae of the tergites.

**HOLOTYPE.** ♀, PANAMA: Canal Zone: Barro Colorado Island, 9.17°N, 79.83°W, 11–18.v.1994, J. Pickering, Malaise trap #2424 [LACM ENT 093710] (LACM).

**PARATYPES.** PANAMA: Canal Zone: Barro Colorado Island, 9.17°N, 79.83°W, 1♀, 10–17.iii.1993, 1♀, 6–13.iv.1994, 1♀, 15–22.vi.1994, J. Pickering, Malaise trap #957, #2419, #2384 (LACM, MIUP).

#### *A. spatulicauda*-subgroup

**DIAGNOSIS.** Frons short. Ovipositor with distinctive line across lateral darkenings, indicating abrupt downturn of direction. Lateral darkenings broad. Ventral apex of ovipositor with dark, heavily sclerotized, transverse sclerite.

**PHYLOGENETIC RELATIONSHIPS.** The characters in the diagnosis are all potential synapomorphies of the group. The relationships among the three species are not resolved.

**WAY OF LIFE.** Unknown.

#### *Apocephalus spatulicauda* Borgmeier (Fig. 67)

*Apocephalus spatulicauda* Borgmeier, 1961:45, figs. 64, 73, 85.

**HOLOTYPE.** ♀, BRAZIL: Rio de Janeiro: Petropolis, 15.vi.1923, T. Borgmeier [LACM ENT 122183] (MZSP; examined).

**SPECIES RECOGNITION.** This species has a distinct ovipositor, with broad lateral darkenings and a narrow preapical sclerite.

**DESCRIPTION.** Unfortunately, the unique female holotype was heavily damaged in the mail. Little remains except the abdomen, so the following description is fragmentary and based in part on the original description of the species.

Body length 1.5 mm. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Mean costal length 0.44 wing length. Halter yellow. Venter of segments 3–5 with a few, scattered setae. Abdomen without dense lateral setae. Ovipositor (Fig. 67) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening broadened, with apical concavity, margin dark, complete. Dorsoapical sclerite of ovipositor elongate, anteriorly emarginate. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded and with short, broad, black, apical darkening. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in southeastern Brazil.

**WAY OF LIFE.** Unknown.

#### *Apocephalus inimicus* Borgmeier (Fig. 68)

*Apocephalus inimicus* Borgmeier, 1961:42, fig. 63.

**HOLOTYPE.** ♀, BRAZIL: Santa Catarina: Nova Teutônia, vii.1952, F. Plaumann, with *Labidus coecus* [LACM ENT 122468] (MZSP; examined).

**SPECIES RECOGNITION.** This species has broad lateral darkenings and an extremely broad, heavily sclerotized preapical sclerite.

**DESCRIPTION.** Body length 1.3–1.4 mm. Frons light brown (bleached from alcohol), anterior margin relatively straight, frons short. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair, greatly reduced. Flagellomere 1 brown, oval. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.42 wing length; range 0.42–0.43. Wing vein  $R_{2+3}$  present. Halter light brown. Abdominal tergites dark brown. Venter of abdomen gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with a few, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 68) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening broadened,

with apical concavity, margin dark, complete. Dorsal apical sclerite of ovipositor rectangular, anteriorly emarginate. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded and with short, broad, black apical darkening. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite a simple, round loop.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in southeastern Brazil.

**WAY OF LIFE.** Although the type specimens were collected with army ants, the host of this species is unknown.

**OTHER MATERIAL EXAMINED.** Paratype ♂, ♀, same data as holotype (MZSP).

### *Apocephalus brevifrons* new species

(Figs. 69, 105)

**SPECIES RECOGNITION.** This species is easily recognized by the extremely enlarged lateral darkenings of the ovipositor, the lack of wing vein  $R_{2+3}$ , and the lack of lower fronto-orbital setae.

**DESCRIPTION.** Body length 1.3–1.4 mm. Frons (Fig. 105) light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, oval (slightly pointed in the male, shown in Fig. 105). Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur slightly darker on anterior face. Mean costal length 0.46 wing length; range 0.43–0.49, slightly thickened. Wing vein  $R_{2+3}$  absent. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow to gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with setae of medium length along posterior margin. Venter of segments 3–5 with short setae, concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 69) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening broadened, with apical concavity, margin dark, complete. Dorsal apical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor pointed. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded and with short, broad, black apical darkening. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite a simple, round loop.

**GEOGRAPHICAL DISTRIBUTION.** Known from mid-elevation sites in Mexico and Costa Rica.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** This species is named for the short frons.

**HOLOTYPE.** ♀, COSTA RICA: San José: Zurquí de Moravia, 10.05°N, 84.02°W, ix–x.1993, P. Hanson, Malaise trap, 1600 m [LACM ENT 014242] (LACM).

**PARATYPES.** MEXICO: Chiapas: Montebello, 1♀, 16.12°N, 91.67°W, 19.vi.1969 (LACM). COSTA RICA: Puntarenas: Monteverde Biological Station, 10.32°N, 84.8°W, 1♂, 25–28.v.1998, B. Brown, V. Berezovskiy, Malaise trap #4, 1500 m (LACM); San José: Zurquí de Moravia, 10.05°N, 84.02°W, 1♂, ii.1989, 1♀, iii.1989, 1♂, 1♀, x–xii.1990, 1♂, 1♀, i.1991, 2♂, iii.1992, 1♀, v.1992, 5♂, vi.1992, 10♂, 3♀, vii.1992, 3♂, iv–v.1993, 12♂, 1♀, 1–15.vi.1993, 9♂, 5♀, ix–x.1993, 5♂, 1♀, ii.1994, 6♂, 3♀, iii.1994, 3♂, 1♀, iv.1994, 4♂, v.1994, 3♂, i.1996, P. Hanson, Malaise trap (INBC, LACM, MCZC, MUCR, MZSP, USNM).

### Other Taxa (subgroup unknown)

#### *Apocephalus densepilosus* Borgmeier

(Figs. 70, 112)

*Apocephalus densepilosus* Borgmeier, 1971:110, figs. 147–148.

**HOLOTYPE.** ♀, BRAZIL: Pará: Utinga, xii.1966, S.J. de Oliveira [LACM ENT 049341] (MZSP; examined).

**SPECIES RECOGNITION.** This species has distinctive extremely dense setation laterally on abdominal segments 4 and 5, unlike other species that have none at all on segment 4 and usually segment 5.

**DESCRIPTION.** Body length 1.5–2.1 mm. Frons yellow, anterior margin relatively straight. One or two pairs of supra-antennal setae present; lower pair smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.55 wing length; range 0.53–0.56. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly and posteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3–5 with few, medial setae. Abdomen with dense lateral setae on segments 4 and 5 (Fig. 112). Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 70) slightly downturned apically, with broad median sclerite. Lateral darkening thin, subparallel, margin dark, complete. Dorsal apical sclerite of ovipositor heart-shaped. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Abdominal glands in segment 5 white,



inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process.

**GEOGRAPHICAL DISTRIBUTION.** Known from Brazil, Colombia, Ecuador, and Peru. The host ant has also been recorded from French Guiana, Trinidad, and Venezuela.

**WAY OF LIFE.** Females are attracted to injured workers of the presumed host species, *Pachycondyla crassinoda* (Latreille).

**MATERIAL EXAMINED.** BRAZIL: Roraima: Ilha de Maracá, 3.37°N, 61.43°W, 2♀, 2–13.v.1987, J. Rafael, Malaise trap (INPA, LACM). COLOMBIA: Amazonas: 7 km W Leticia, 4.13°S, 69.9°W, 1♀, 26.viii.1997, B. Brown, G. Kung, injured *Pachycondyla crassinoda* (LACM). ECUADOR: Napo: Yasuni Biological Research Station, 0.67°S, 76.36°W, 1♀, 24.v.1996, B. Brown, injured *P. crassinoda* (LACM); Sucumbios: Añagu, 0.48°S, 76.38°W, 1♀, 9.ix.1997, P. DeVries, injured *P. crassinoda* (LACM), Sacha Lodge, 0.5°S, 76.5°W, 1♀, 14–24.iii.1994, 1♀, 14–24.v.1994, P. Hibbs, Malaise trap, 270 m (LACM, QCAZ). PERU: Madre de Dios, Zona Reserva Pakitza, 11.94°S, 71.28°W, 1♀, 14.ii.1992, 1♀, 27.ii.1992, B. Brown, D. Feener, injured *P. crassinoda* (MUSM, USNM).

### *Apocephalus comosus* new species

(Figs. 71, 113)

**SPECIES RECOGNITION.** This species is easily recognized by the lateral group of setae on abdominal segment 5 and the distinctive shape of the preapical sclerite.

**DESCRIPTION.** Body length 1.8–2.5 mm. Frons yellow to dark brown, anterior margin produced between antennae. One pair of supra-antennal setae present. Flagellomere 1 yellow to light brown, round. Proboscis elongate; anterior margin of frons produced anteriorly. Palpus brown. Dorsum of thorax light brown; pleuron white, strongly and sharply contrasting with scutum. Anterior scutellar seta slightly enlarged, bristle-like. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.58 wing length; range 0.55–0.61. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites 2 extremely short; 3–5 elongate in compensation. Tergite 3 dark, with round, yellow spot laterally. Tergite 6 anteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3–5 bare. Abdomen with patch of long, dense lateral setae on a small evagination on segment 6 (Fig. 113). Ventral setae of segment 6 long, consisting of single median pair. Ovipositor (Fig. 71) slightly upturned apically, evenly sclerotized, with long, thin, posteromedial process dorsally. Lateral darkening thin, subparallel, margin dark, complete. Dorsapical sclerite of ovipositor spade-shaped. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor rounded. Ovipositor without ventral

postapical sclerite. Sternite 7 broad, with pointed, mediolateral projection. Dufour's mechanism round. Abdominal glands in segment 5 dark, enlarged, elongate, clearly visible in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** This species is widely distributed in the lowlands throughout the Neotropical Region, from southern Mexico to Ecuador.

**WAY OF LIFE.** One female of this species was attracted to injured *Ectatomma tuberculatum* workers; one was attracted to an injured *Odontomachus laticeps*. The actual host ant of this relatively commonly collected species is still unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for hairy, referring to the highly setose abdomen.

**HOLOTYPE.** ♀, COSTA RICA: Puntarenas: 3 km SW Rincon, 8.68°N, 83.48°W, iii–v.1991, P. Hanson, Malaise trap, 10 m [LACM ENT 012879] (LACM).

**PARATYPES.** COSTA RICA: Alajuela: San Pedro de la Tigua, 10.37°N, 84.57°W, 1♀, ii.1990, P. Hanson, Malaise trap, 200 m (LACM); Guanacaste: Volcan Cacao, Cerro Pedregal, 10.93°N, 85.48°W, 1♀, ii–iv.1989, I. Gauld, D. Janzen, Malaise trap, 1000 m (LACM); Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 2♀, 1–8.v.1989, 1♀, 8–15.v.1989, 1♀, 15–21.v.1989, B. Brown, D. Feener, Malaise trap, SHO@SOR (LACM), 2♀, iii.1991, P. Hanson, Malaise trap (LACM, MUCR), 1♀, 15.ii–1.iii.1993, ALAS, Malaise trap M/10/25 (INBC), 1♀, 1–15.iii.1993, ALAS, Malaise trap M/10/41 (INBC), 3♀, 1–15.iv.1993, ALAS, Malaise trap M/08/71, M/12/75, M/15/78 (INBC), 2♀, 1–15.v.1993, ALAS, Malaise trap M/10/104 (INBC), 1♀, 15.vi–1.vii.1993, ALAS, Malaise trap M/06/151 (INBC), 1♀, 15.vi–1.vii.1993, ALAS, Malaise trap M/12/118 (INBC), 1♀, 22–24.vi.1993, B. Brown, D. Feener, Malaise trap #1 (LACM), 1♀, 24.vi.1993, B. Brown, injured *Ectatomma tuberculatum* (LACM), 2♀, 1.vii.1993, ALAS, Malaise trap M/12/146 (INBC), 2♀, 15.vii.1993, ALAS, Malaise trap M/12/162 (INBC), 2♀, 3.viii.1993, ALAS, Malaise trap, M/12/174 (INBC), 1♀, 15.xi.1993, ALAS, Malaise trap M/04/267 (INBC), 4♀, 15.xi.1993, ALAS, Malaise trap M/12/274 (INBC), 2♀, 3.i.1994, ALAS, Malaise trap, M/01/304, M/09/311 (INBC), 1♀, 15.i.1994, ALAS, Malaise trap M/08/326 (INBC), 1♀, 15.ii.1994, ALAS, Malaise trap, M/05/352 (INBC), 1♀, 1.iii.1994, ALAS, Malaise trap, M/04/363 (INBC), 1♀, 30.vi.1995, ALAS, Malaise trap M/01/388 (INBC), 1♀, 1.xii.1995, ALAS, Malaise trap M/01/507 (INBC), 1♀, 15.x.1997, ALAS, Malaise trap M/18/686 (INBC); Limón: 4 km NE Bribri, 9.63°N, 82.82°W, 2♀, xii.1989–iii.1990, P. Hanson, Malaise trap, 50 m (LACM), 7 km SW Bribri, 9.58°N, 82.88°W, 2♀, ix–x.1989, P. Hanson, Malaise trap (LACM), 16 km W Guapiles, 10.15°N, 83.92°W, 1♀, i–iv.1991, P. Hanson, Malaise trap, 400 m (LACM); Puntar-

enas: Coopemarti, 8.63°N, 83.47°W, 6♀, ii.1991, P. Hanson, Malaise trap, 30 m (LACM), 5 km W Piedras Blancas, 8.77°N, 83.28°W, 1♀, vi–viii.1989, 2♀, vi.1991, 1♀, vii.1991, 1♀, viii.1991, P. Hanson, Malaise trap, 100 m (LACM), 10 km W Piedras Blancas, 8.75°N, 83.3°W, 2♀, iii–v.1989, P. Hanson, Malaise trap, 100 m (LACM), 24 km W Piedras Blancas, 8.77°N, 83.4°W, 1♀, iii–v.1989, 1♀, xii.1991, P. Hanson, Malaise trap (LACM), 5 km NW Puerto Jimenez, 8.55°N, 83.35°W, 1♀, v.1991, P. Hanson, Malaise trap, 10 m (LACM), 23 km N Puerto Jimenez, 8.67°N, 83.45°W, 1♀, i–iv.1991, 2♀, viii.1991, P. Hanson, Malaise trap, 10 m (LACM), 3 km SW Rincon, 8.68°N, 83.48°W, 1♀, iii.1989, 1♀, xii.1989, 1♀, iii–vi.1990, 1♀, vii–ix.1990, 6♀, iii–v.1991, 2♀, viii.1991, 1♀, x.1991, 1♀, ii.1992, P. Hanson, Malaise trap, 10 m (LACM, MUCR), 5 km SW Rincon, 8.7°N, 83.51°W, 4♀, 31.v–7.vi.1998, B. Brown, V. Berezovskiy, Malaise trap #3, Malaise trap #5 (LACM), 1♀, 3.vi.1998, B. Brown, injured *Odontomachus laticeps* (LACM), Rio Piro, 8.28°N, 83.32°W, 1♀, ii.1991, P. Hanson, Malaise trap, 75 m (LACM); San José: Zurquí de Moravia, 10.05°N, 84.02°W, 1♀, vii.1990, P. Hanson, Malaise trap, 1600 m (LACM). ECUADOR: Sucumbios: Sacha Lodge, 0.5°S, 76.5°W, 1♀, 3–13.vi.1994, P. Hibbs, Malaise trap, 270 m (QCAZ), Tiputini Station, 0.67°S, 76.25°W, 1♀, 28–30.vi.1998, E. Holscher, C. Carter, Malaise trap (LACM). MEXICO: Veracruz: 33 km NE Catemaco, Los Tuxtlas Biological Station, 1♀, 1.vii–1.viii.1983, S. and J. Peck, FIT, rain forest, 160 m (LACM). PANAMA: Canal Zone: Barro Colorado Island, 9.15°N, 79.85°W, 1♀, 20–27.i.1993, J. Pickering, Malaise trap #736 (LACM), 1♀, 10–17.iii.1993, J. Pickering, Malaise trap #957, 9♀, 24–31.iii.1993, J. Pickering, Malaise trap #935, #959 (LACM, MIUP), 1♀, 28.iv–5.v.1993, J. Pickering, Malaise trap #940 (LACM), 3♀, 5–12.v.1993, J. Pickering, Malaise trap #941 (LACM), 1♀, 9–23.vi.1993, J. Pickering, Malaise trap #946 (LACM), 1♀, 25.viii–1.ix.1993, J. Pickering, Malaise trap #1676 (LACM), 1♀, 8–15.ix.1993, J. Pickering, Malaise trap #1672 (LACM), 23♀, 6–13.x.1993, J. Pickering, Malaise trap #1693 (LACM, MCZC, MIUP, MUSP, USNM), 1♀, 2–9.ii.1994, J. Pickering, Malaise trap #2366 (LACM), 1♀, 11–18.v.1994, J. Pickering, Malaise trap #2424 (LACM), 1♀, 22–29.vi.1994, J. Pickering, Malaise trap #2385 (LACM), 2♀, 24–31.viii.1994, J. Pickering, Malaise trap #2394 (LACM), 4♀, 6–13.xi.1996, J. Pickering, Malaise trap #7046 (LACM); San Blas: Nusagandi Reserve, 9.33°N, 79°W, 1♀, 14–21.v.1994, J. Pickering, Malaise trap #2871 (LACM).

### *Apocephalus lobicauda* new species (Fig. 72)

**SPECIES RECOGNITION.** This species is recognized by its short, broad, rounded lateral darkenings.

**DESCRIPTION.** Body length 1.1–1.4 mm. Frons yellow to light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.43 wing length; range 0.40–0.45. Wing vein  $R_{2+3}$  present. Halter light brown. Abdominal tergites dark brown. Venter of abdomen yellow to gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 72) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening broadened, enlarging posteriorly, apically rounded, margin dark, complete. Dorsal apical sclerite of ovipositor trapezoidal, but anteriorly emarginate. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a number of lowland sites in Costa Rica.

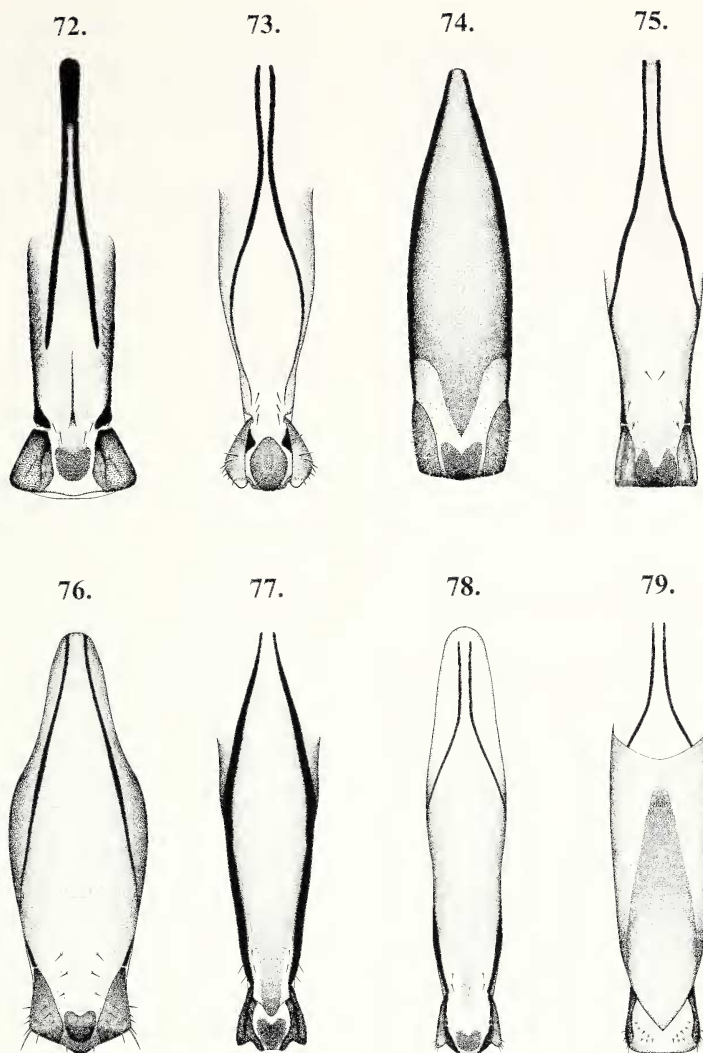
**WAY OF LIFE.** Females are attracted to injured *Ectatomma tuberculatum* workers.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin words *lobus* and *cauda*, for lobe and tail, referring to the shape of the lateral darkenings.

**HOLOTYPE.** ♀, COSTA RICA: Limón: 7 km SW Bribri, 9.58°N, 82.88°W, ix–xi.1989, P. Hanson, Malaise trap [LACM ENT 005279] (LACM).

**PARATYPES.** COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 2♀, 1–15.iv.1993, ALAS, Malaise trap M/15/78, M/01/64 (INBC), 1♀, 1.vi.1993, ALAS, Malaise trap M/7/113 (INBC), 1♀, 1.vii.1993, ALAS, Malaise trap M/06/151 (INBC), 1♀, 1–15.vii.1993, ALAS, Malaise trap M/10/160 (INBC), 1♀, 1.xi.1993, ALAS, Malaise trap M/01/248 (INBC), 10♀, 1.xii.1993, ALAS, Malaise trap M/01/276 (INBC, LACM), 8♀, 3.i.1994, ALAS, Malaise trap M/01/304 (INBC, MCZ, USNM) 1♀, 1.iii.1994, ALAS, Malaise trap M/01/360 (INBC), 2♀, 4.iv.1994, ALAS, Malaise trap M/01/384 (INBC), 2♀, 15.vii.1995, 2♀, 19.vii.1995, D. Feener, injured *Ectatomma tuberculatum* (LACM); Limón: 4 km NE Bribri, 9.63°N, 82.82°W, 1♀, xii.1989–iii.1990, P. Hanson, Malaise trap, 50 m (LACM), 7 km SW Bribri, 9.58°N, 82.88°W, 4♀, ix–xi.1989, P. Hanson, Malaise trap (LACM, MUCR); Puntarenas: 24 km W Piedras Blancas, 8.77°N, 83.4°W, 1♀, iv–v.1991, P. Hanson, Malaise trap (LACM), 3 km SW Rincon,





Figures 72-79. Ovipositors. 72. *Apocephalus lobicauda* new species, dorsal. 73. *Apocephalus globosus* new species, dorsal. 74. *Apocephalus maculosus* new species, dorsal. 75. *Apocephalus glabriventris* new species, dorsal. 76. *Apocephalus minutus* Borgmeier, dorsal. 77. *Apocephalus cardiacus* new species, dorsal. Figures 78-79. *Apocephalus petiolus* new species. 78. Dorsal. 79. Ventral.

8.68°N, 83.48°W, 2 ♀, x-xii.1990, P. Hanson, Malaise trap (LACM), Sirena, 8.48°N, 83.6°W, 1 ♀, 9.vii.1993, D. Feener, injured *E. tuberculatum* (LACM).

### *Apocephalus globosus* new species (Fig. 73)

**SPECIES RECOGNITION.** This species is recognized by the distinctive large rounded preapical sclerite.

**DESCRIPTION.** Body length 1.4 mm. Frons light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light

brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3-5 with short setae, concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 73) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening broadened, en-

larging posteriorly, apically rounded, margin dark, complete. Dorsoapical sclerite of ovipositor large, round, dark, shiny. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 triangular, apically tridentate and with apical, triangular sclerite. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite a simple, round loop.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in northern Costa Rica.

**WAY OF LIFE.** The single specimen was attracted to injured *Pachycondyla villosa* workers.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for round, referring to the shape of the preapical sclerite.

**HOLOTYPE.** ♀, COSTA RICA: Guanacaste: Estación Biología Pitilla, 11.0°N, 85.43°W, 5.vii.1997, B. Brown, injured *Pachycondyla villosa* [LACM ENT 099871] (LACM).

### *Apocephalus maculosus* new species

(Figs. 74, 110)

**SPECIES RECOGNITION.** This species is distinguished by light-colored spots on tergite 3 and the unusual structure of the ovipositor.

**DESCRIPTION.** Body length 1.5 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellow; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.55 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 dark, with round, yellow spot laterally (Fig. 110). Tergite 6 anteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3–5 bare, except for small patch of setae mediolaterally on segment 5. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 74) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening broad, margin dark, complete. Dorsoapical sclerite of ovipositor trapezoidal, but anteriorly emarginate. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 triangular. Dufour's mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite rounded, with a short process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in Amazonian Ecuador.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin word *maculosus* for

spotted, referring to the light-colored, round spots on tergite 3.

**HOLOTYPE.** ♀, ECUADOR: Sucumbios: Sacha Lodge, 0.5°S, 76.5°W, 1–31.xii.1994, P. Hibbs, Malaise trap, 270 m [LACM ENT 050741] (LACM).

### *Apocephalus glabriventris* new species

(Fig. 75)

**SPECIES RECOGNITION.** This species belongs to a group of similar species with small preapical sclerites on the ovipositor. It is recognized by the large notch in the anterior margin of the sclerite, as well as the bare venter of the abdomen.

**DESCRIPTION.** Body length 1.0 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 75) straight in lateral view, lightly but evenly sclerotized dorsally, darker than in similar species. Lateral darkening posteriorly enlarged, truncate, margin dark, complete. Dorsoapical sclerite of ovipositor heart-shaped. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in western Mexico.

**WAY OF LIFE.** The single known specimen of this species was attracted to a pair of fighting *Ectatomma ruidum* (Roger)

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin words *glaber* and *ventris*, for bare and belly, referring to the bare venter of the abdomen.

**HOLOTYPE.** ♀, MEXICO: Jalisco: Chamela, 19.52°N, 105.08°W, 1.x.1990, W. Eberhard, over fighting *Ectatomma ruidum* [LACM ENT 012756] (LACM).

### *Apocephalus minutus* Borgmeier

(Fig. 76)

*Apocephalus minutus* Borgmeier, 1958:329, figs. 20, 20a, 39.



*Apocephalus angularis* Borgmeier, 1971:106–107, fig. 149, new synonymy.

**HOLOTYPE.** ♀, BRAZIL: Rio de Janeiro: Jacarepaguá, 1957, T. Borgmeier (MZSP; not examined).

**SPECIES RECOGNITION.** This species is distinguished by the small heart-shaped preapical sclerite and the downturned apex of the ovipositor.

In his last key to *Apocephalus* species, Borgmeier (1971) stated that *A. angularis* Borgmeier had an apically pointed ovipositor, unlike *A. minutus*, which was stated to have a small, triangular excision. This apparent excision, however, was an artifact of the drying of the intersegmental membrane posterior to the ovipositor. Examination of specimens of *A. angularis* showed that they are identical to *A. minutus*.

**DESCRIPTION.** Body length 1.0 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur slightly darker on anterior face. Mean costal length 0.46 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with long seta at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 76) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, truncate, margin dark, complete. Dorsoapical sclerite of ovipositor elongate, anteriorly emarginate. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 thin, with lighter, expanded area at midlength. Dufour's mechanism not seen. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in southeastern Brazil.

**WAY OF LIFE.** Unknown.

**MATERIAL EXAMINED.** BRAZIL: Rio de Janeiro: Jacarepaguá, 1 ♀ [paratype], 18.xi.1957, T. Borgmeier (MCZC); São Paulo: Nova Teutonia, 2 ♀ [holotype and paratype of *A. angularis*], F. Plaumann (MZSP).

### *Apocephalus cardiacus* new species

(Fig. 77)

**SPECIES RECOGNITION.** This species can be recognized by the heart-shaped preapical sclerite and the small, internally directed arms of the apex of the lateral darkenings. It differs from the most

similar species, *A. petiolus* new species, by the relatively short, sparse setae on the venter of the abdomen.

**DESCRIPTION.** Body length 1.4–1.8 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta large, bristle-like. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.52 wing length; range 0.50–0.56. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown (some specimens with tergite 3 light brown). Venter of abdomen yellow to gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with short setae, concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 relatively short, consisting of a complete ventral and lateral row. Ovipositor (Fig. 77) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, truncate, margin dark, complete. Dorsoapical sclerite of ovipositor heart-shaped. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 broad, narrowed apically, but widened abruptly at apex. Dufour's mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite rounded, with long process.

**GEOGRAPHICAL DISTRIBUTION.** Known from several lowland sites in Costa Rica.

**WAY OF LIFE.** Host unknown. This species was collected almost exclusively by Malaise trap #10 in the 16-trap ALAS survey. In Brown and Feener (1995, as "species 143"), the increase in abundance of this species in trap #10 was hypothesized to be correlated with the onset of the rainy season.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Greek word *kardia* for heart, referring to the shape of the preapical sclerite.

**HOLOTYPE.** ♀, COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 1–15.v.1993, ALAS, Malaise trap M/10/104 [INBI-OCRI001264537] (INBC).

**PARATYPES.** COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 3 ♀, ix.1992, P. Hanson, Malaise trap (LACM, MUCR), 2 ♀, 15.ii–1.iii.1993, ALAS, Malaise trap M/10/25 (INBC), 2 ♀, 15.iv–1.v.1993, ALAS, Malaise trap M/10/89 (INBC), 12 ♀, 1–15.v.1993, ALAS, Malaise trap M/10/104 (INBC), 17 ♀, 15.v–1.vi.1993, ALAS, Malaise trap M/10/116 (INBC, LACM), 11 ♀, 1–15.vi.1993, ALAS, Malaise trap M/10/132 (INBC, LACM), 1 ♀, 15.vi–1.vii.1993, ALAS, Malaise trap M/04/139 (INBC), 25 ♀, 15.vi–1.vii.1993, ALAS, Malaise trap M/10/144 (INBC, LACM), 12 ♀, 1–15.vii.1993, ALAS, Malaise trap M/10/160 (INBC, LACM), 17 ♀, 15.vii–3.viii.1993, ALAS,

Malaise trap M/10/172 (INBC, MCZC, USNM), 3♀, 3.viii.1993, ALAS, Malaise trap M/12/174 (INBC), 14♀, 3–14.viii.1993, ALAS, Malaise trap M/10/188 (INBC), 11♀, 15.viii–1.ix.1993, ALAS, Malaise trap M/10/200 (INBC), 1♀, 1.xi.1993, ALAS, Malaise trap M/02/249 (INBC), 1♀, 2.i.1996, ALAS, Malaise trap M/01/531 (INBC), Rara Avis, 12 km SW Horquetas, 1♀, 18–23.i.1989, D.A. Grimaldi, 550 m (AMNH); Puntarenas: 24 km W Piedras Blancas, 8.77°N, 83.4°W, 1♀, i.1992, P. Hanson, Malaise trap, 200 m (LACM), 23 km N Puerto Jimenez, 8.67°N, 83.45°W, 1♀, viii.1991, P. Hanson, Malaise trap (LACM).

### *Apocephalus petiolus* new species

(Fig. 78–79, 109)

**SPECIES RECOGNITION.** This species is recognized by the shape of the preapical sclerite and by the densely setose, “hairy” appearance of the venter of the abdomen.

**DESCRIPTION.** Body length 1.4 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellow; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.55 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 complete, with short setae at posterolateral corner. Venter of segments 3–5 with long, dense setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 78–79) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, inner margin extended medially, margin dark, complete. Dorsoapical sclerite of ovipositor small, triangular. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 broad, narrowed apically. Dufour’s mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite rounded, with long process (Fig. 109).

**GEOGRAPHICAL DISTRIBUTION.** Known from a few lowland sites in Costa Rica.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for small stem, referring to the sclerotized loop.

**HOLOTYPE.** ♀, COSTA RICA: Puntarenas: Rio Piro, 8.28°N, 83.32°W, ii.1991, P. Hanson, Malaise trap, 75 m [LACM ENT 004854] (LACM).

**PARATYPES.** COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 1♀,

2.iii.1993, ALAS, Malaise trap, M/05/20, 1♀, 4.iv.1994, ALAS, Malaise trap, M/11/389 (INBC); Puntarenas: 24 km W Piedras Blancas, 8.77°N, 83.4°W, 1♀, xi.1990, P. Hanson, Malaise trap, 200 m (LACM).

### *Apocephalus gigantivorus* new species

(Figs. 80–81)

**SPECIES RECOGNITION.** This species has a distinctive preapical sclerite that is much longer than broad.

**DESCRIPTION.** Body length 1.9–2.3 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 basally yellow, apically brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax yellow; pleuron white. Anterior scutellar seta large, bristle-like. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.52 wing length; range 0.51–0.54. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, lighter medially. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 80–81) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, inner margin extended posteriorly, margin dark, complete. Dorsoapical sclerite of ovipositor elongate, rounded anteriorly. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 triangular. Dufour’s mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known only from Brazil, but the host ant is also known from Peru (Kempf, 1971).

**WAY OF LIFE.** Females were attracted to injured *Dinoponera gigantea*. They were mentioned by Silveira-Costa and Moutinho (1996, p. 94) in their paper about phorid parasitoids of *Dinoponera*.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the species name of the host and the Latin word *vor*o, for eat.

**HOLOTYPE.** ♀, BRAZIL: Paragominas: 3°S, 47.5°W, 10.v.1995, A. Silveira-Costa, over *Dinoponera gigantea* [LACM ENT 006557] (MZSP).

**PARATYPES.** BRAZIL: Paragominas: 3°S, 47.5°W, 1♀, v.1994, 5♀, 10.v.1995, A. Silveira-Costa, over *Dinoponera gigantea* (LACM, MZSP).

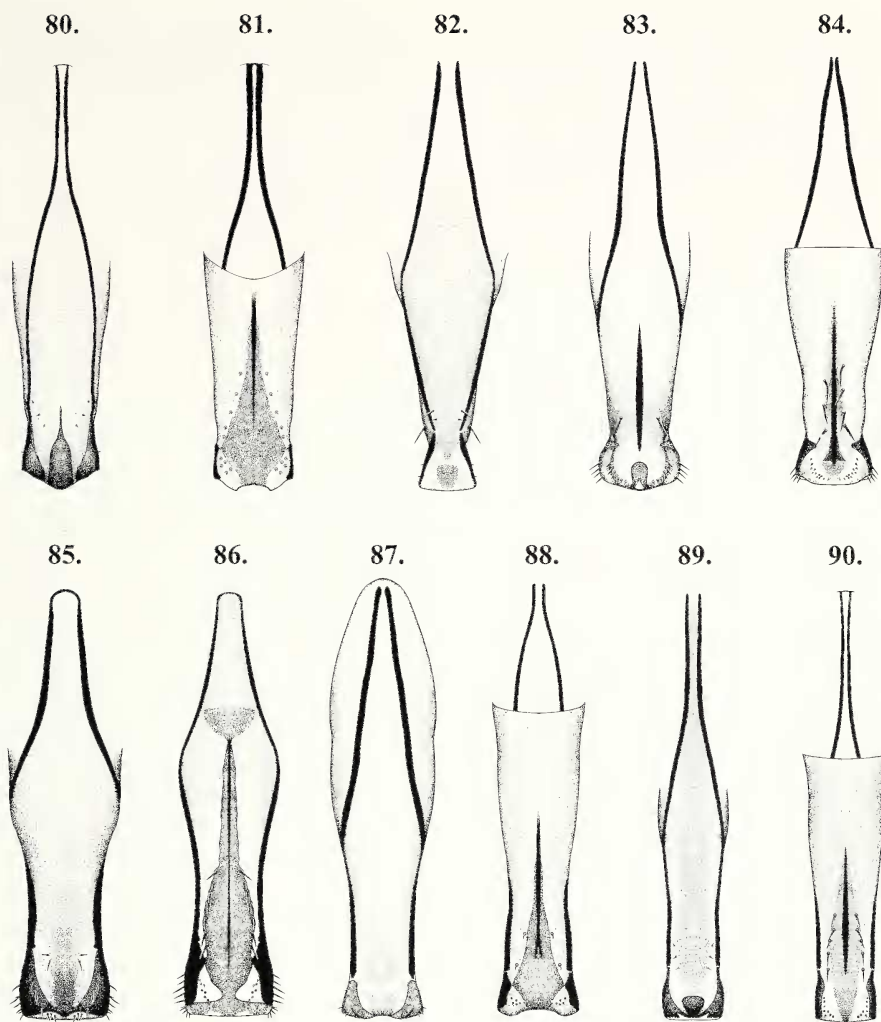
### *Apocephalus piliiventris* Borgmeier

(Fig. 82)

*Apocephalus piliiventris* Borgmeier, 1925:186, figs. 18, 19, Plate VIII, fig. 39.

*Lectotype* (here designated). ♀, BRAZIL: Rio de





Figures 80-90. Ovipositors. Figures 80-81. *Apocephalus gigantivorus* new species. 80. Dorsal. 81. Ventral. 82. *Apocephalus piliventris* Borgmeier, dorsal. Figures 83-84. *Apocephalus annulatus* new species. 83. Dorsal. 84. Ventral. Figures 85-86. *Apocephalus contortiventris* new species. 85. Dorsal. 86. Ventral. Figures 87-88. *Apocephalus eurydomus* new species. 87. Dorsal. 88. Ventral. Figures 89-90. *Apocephalus conformalis* new species. 89. Dorsal. 90. Ventral.

Janeiro, Petrópolis, 22.52°S, 43.17°W [LACMENT 121126] (MZSP).

**SPECIES RECOGNITION.** This species is most easily recognized by the thin, divergent lateral darkenings of the ovipositor.

**DESCRIPTION.** Body length 1.4-1.6 mm. Frons yellow, anterior margin relatively straight. One to two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellow; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.51 wing length; range 0.50-0.52. Wing vein  $R_{2+3}$  present. Halter brown.

Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3-5 with long, dense setae concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 82) straight in lateral view, lightly and evenly sclerotized dorsally with thin, dark, median line. Lateral darkening thin, apically divergent, margin dark, complete. Dorsoapical sclerite of ovipositor heart-shaped. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 triangular. Abdominal glands in segment 5 white,

inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a few sites in southeastern Brazil.

**WAY OF LIFE.** Females were attracted to injured workers of *Pachycondyla striata* Smith in the urban park next to the Museu de Zoologia, São Paulo, Brazil.

**MATERIAL EXAMINED.** BRAZIL: Minas Gerais: Congonhas, 1♀, 22–24.ii.1990, S.A. Marshall, pan trap (DEBU); Rio de Janeiro: Petropolis, 1♀, 2.iii.1923, 1♀, 7.iv.1923, 1♂, 24.iv.1923, 1♀, 2.v.1923, Ronchi (MCZC, USNM), 1♂, 3♀, no other data (LACM, MZSP); Santa Catarina: Nova Teutonia, 1♀ [no date], F. Plaumann (MZSP); São Paulo: Parque do Ipiranga, 23.59°S, 46.61°W, 2♀, 29.iv.1999, 6♀, 1.v.1999, B. Brown, injured *Pachycondyla striata* (LACM, MZSP).

### *Apocephalus annulatus* new species

(Figs. 83–84)

**SPECIES RECOGNITION.** This species is recognized by the posterior cleft in the dorsal preapical sclerite and by the rounded lateral darkenings.

**DESCRIPTION.** Body length 1.5–1.8 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length; range 0. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites yellow, posteriorly dark brown; tergite 6 completely yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with short setae, concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 moderately long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 83–84) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, inner margin extended medially, margin dark, complete. Dorsoapical sclerite of ovipositor rectangular, posteriorly cleft. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 triangular, apically tridentate and with apical, triangular sclerite. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite rounded, with a short process.

**GEOGRAPHICAL DISTRIBUTION.** Known from two sites in eastern Costa Rica.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The

name is a Latin word for circular, referring to the rounded lateral darkenings of this species.

**HOLOTYPE.** ♀, COSTA RICA: Limon: 16 km W Guapiles, 10.15°N, 83.92°W, i–iv.1991, P. Hanson, Malaise trap, 400 m [LACM ENT 013196] (LACM).

**PARATYPES.** COSTA RICA: Limon: 4 km NE Bribri, 9.63°N, 82.82°W, 1♀, vii–ix.1990, P. Hanson, Malaise trap, 50 m (LACM).

### *Apocephalus contortiventris* new species

(Figs. 85–86)

**SPECIES RECOGNITION.** This species can be recognized by the extremely complex shape of sternite 7.

**DESCRIPTION.** Body length 1.5 mm. Frons light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus brown. Dorsum of thorax light brown; pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.5 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with several long setae on posterior margin. Venter of segments 3–5 with long, dense setae concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 85–86) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, inner margin extended medially, margin dark, complete. Dorsoapical sclerite of ovipositor rectangular. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 anteriorly triangular, posteriorly narrowed, then broadly expanded to an oval with numerous lateral setae, then narrowed and expanded to broad posterior apex. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in western Ecuador.

**WAY OF LIFE.** The single specimen was attracted to an injured worker of *Pachycondyla impressa*.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin words *contortus* and *venter*, for complex and belly, referring to the complicated structure of sternite 7.

**HOLOTYPE.** ♀, ECUADOR: Esmeraldas: Bilsa Biological Station, 0.34°N, 79.71°W, 10.v.1996, B. Brown, injured *Pachycondyla impressa*, 500 m [LACM ENT 053897] (LACM).



### *Apocephalus eurydomus* new species

(Figs. 87–88, 106, 111)

*Apocephalus* sp., Brown 1992, fig. 35B–D.

**SPECIES RECOGNITION.** This species is best recognized by the medial ventral setae of the abdomen, the apically expanded sternite 7 and the small preapical sclerite. The most similar species is *A. conformalis* new species, which differs in the form of sternite 7.

**DESCRIPTION.** Body length 1.3–1.6 mm. Frons yellow to light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow to light brown. Anterior scutellar seta slightly enlarged, bristle-like. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.49 wing length; range 0.47–0.5. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with short setae, concentrated medially (Fig. 111). Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 87–88) slightly downturned apically, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, truncate, margin dark, complete. Dorsoapical sclerite of ovipositor trapezoidal. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process (Fig. 106).

**GEOGRAPHICAL DISTRIBUTION.** Known from the southern USA to Panama.

**WAY OF LIFE.** Presumably, this species is a parasitoid of *Pachycondyla harpax* (Fabricius). Females were attracted to a chemical extract of workers of this ant in Texas.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Greek words *eury*s, for wide-spread, and *doma* for home. It refers to the large geographic range of this species, the only member of the *A. miricauda*-group to occur in the Nearctic Region.

**HOLOTYPE.** ♀, USA: Texas: Travis County, Austin 30.3°N, 97.78°W, 9.vii.1994, D. Feener, attracted to *Pachycondyla harpax* extract [LACM ENT 031026] (LACM).

**PARATYPES.** COSTA RICA: Cartago: Dulce Nombre, 9.83°N, 83.92°W, 2♀, vi–viii.1993, P. Hanson, Malaise trap, 1400 m (LACM); San José: Ciudad Colon, 9.92°N, 84.25°W, 3♀, ii.1990, 7♀, iii–iv.1990, 2♀, iv–v.1990, P. Hanson, Malaise trap, 800 m (INBC, LACM, MUCR). PANAMA:

Canal Zone: Balboa, Ancon Hill, 2♀, 26–29.iv.1983, G. Otis, pan trap (LACM). USA: Texas: Bastrop County, Bastrop State Park, 30.12°N, 97.35°W, 1♀, 1–12.iii.1991, R. Wharton, Malaise trap (TAMU), Travis County, Austin, 30.3°N, 97.78°W, 1♀, 9.vii.1994, D. Feener, attracted to *Pachycondyla harpax* extract (LACM).

### *Apocephalus conformalis* new species

(Figs. 89–90)

**SPECIES RECOGNITION.** This species is similar to *A. eurydomus* but has a different form of sternite 7.

**DESCRIPTION.** Body length 1.4–1.6 mm. Frons light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white to light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length; range 0.45–0.48. Wing vein  $R_{2+3}$  present. Halter light brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with short setae, concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 89–90) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, truncate, margin dark, complete. Dorsoapical sclerite of ovipositor trapezoidal. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 broad, narrowed apically but widened abruptly at apex. Dufour's mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in Amazonian Brazil.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for similar, referring to the close similarity of this species to *A. eurydomus*.

**HOLOTYPE.** ♀, BRAZIL: Roraima: Ilha de Maracá, 3.37°N, 61.43°W, 2–13.v.1987, J. Rafael, Malaise trap [LACM ENT 012754] (INPA).

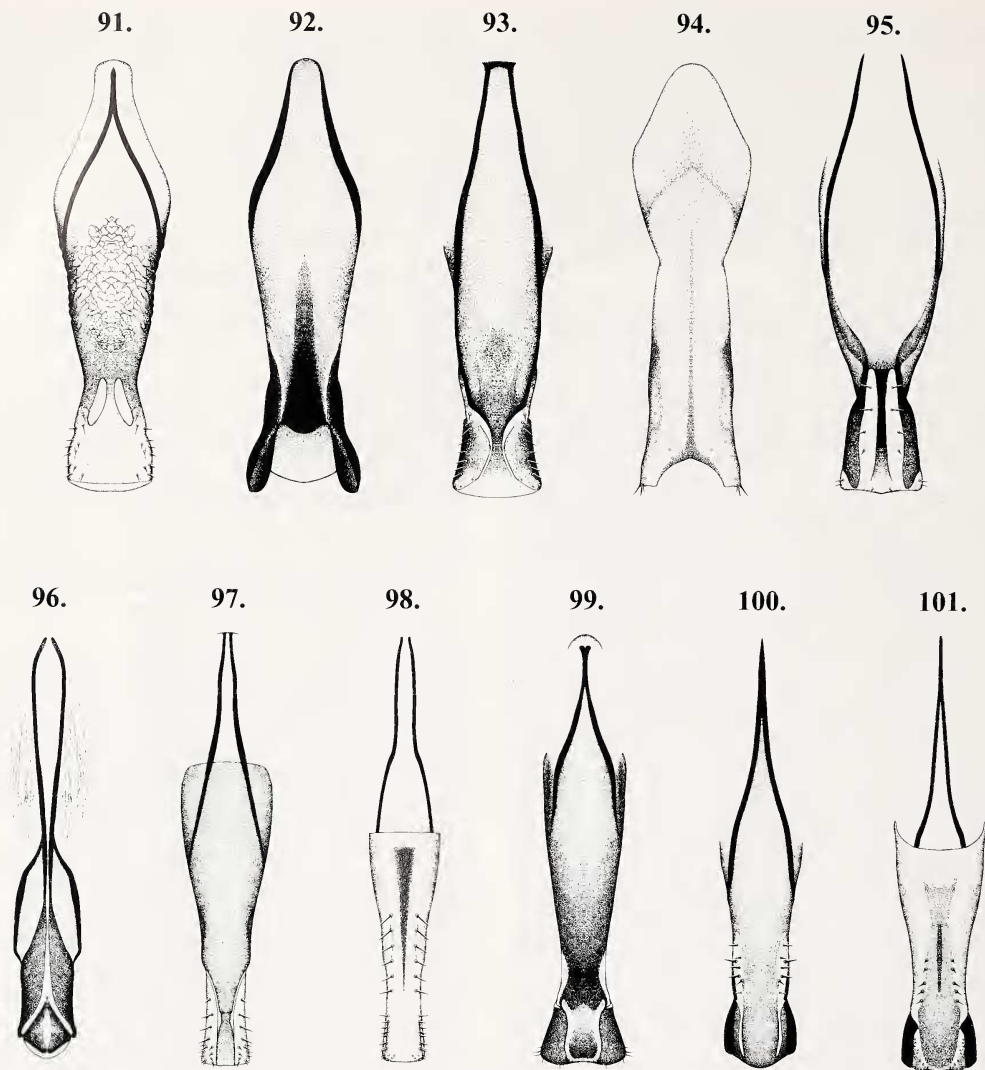
**PARATYPES.** 30♀, same data as holotype (INPA, LACM, MCZC, MZSP, USNM).

### *Apocephalus fenestratus* new species

(Fig. 91)

**SPECIES RECOGNITION.** This species is instantly recognizable by the peculiar clear sections in the ovipositor.

**DESCRIPTION.** Body length 1.3 mm. Frons



Figures 91-101. Ovipositors. 91. *Apocephalus fenestratus* new species, dorsal. 92. *Apocephalus asyndetus* new species, dorsal. 93. *Apocephalus catholicus* new species, dorsal. 94. *Apocephalus lyratus* Borgmeier, dorsal. 95. *Apocephalus trifidus* new species, dorsal. 96. *Apocephalus tanyurus* new species, dorsal. Figures 97-98. *Apocephalus contracticauda* new species. 97. Dorsal. 98. Ventral. 99. *Apocephalus indistinctus* new species, dorsal. Figures 100-101. *Apocephalus dinoponerae* new species. 100. Dorsal. 101. Ventral.

light brown, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, oval. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron light brown. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.48 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen white. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with several long setae on posterior margin. Venter of segments 3-5 with a few,

scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 91) slightly upturned apically, evenly sclerotized, but with a pair of clear areas. Lateral darkening not differentiated. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single mid-elevation site in Costa Rica.



**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is from a Latin word, *fenestra*, for window.

**HOLOTYPE.** ♀, COSTA RICA: Cartago: La Cangreja, 9.8°N, 83.97°W, iii–v.1992, P. Hanson, Malaise trap, 1950 m [LACM ENT 013053] (LACM).

**PARATYPE.** COSTA RICA: Cartago: La Cangreja, 9.8°N, 83.97°W, 1 ♀, vi–vii.1992, P. Hanson, Malaise trap, 1950 m (LACM).

### *Apocephalus asyndetus* new species

(Fig. 92)

**SPECIES RECOGNITION.** This widespread species is easily recognized by the distinctive ovipositor. Specimens from South America are consistently lighter in color, especially in flagellomere 1, but do not differ from Central American specimens in any other substantial way.

**DESCRIPTION.** Body length 1.4–1.9 mm. Frons yellow to dark brown, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair extremely small. Flagellomere 1 light brown to brown, oval, enlarged. Proboscis normal, small. Palpus brown. Dorsum of thorax yellow to light brown; pleuron yellow to white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.49 wing length; range 0.45–0.52. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown to yellow, posteriorly dark brown; tergite 6 completely yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with long seta at posterolateral corner. Venter of segments 3–5 with short setae, concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete lateral row and a medial group centered on a small sclerite. Ovipositor (Fig. 92) straight in lateral view, with broad median sclerite. Lateral darkening thin, extended posteriorly from apex of ovipositor, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 broad, lightly sclerotized. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Lowland Brazil, Costa Rica, Ecuador, Panama, and Peru. The host ant, *Gnamptogenys bispinosa* (Emery), is known from Costa Rica and Colombia (Lattke, 1995).

**WAY OF LIFE.** One specimen was collected attacking workers of *Gnamptogenys bispinosa* as they were being raided by the army ant *Eciton vagans* (Olivier) (Brown and Feener, 1998).

**DERIVATION OF SPECIFIC EPITHET.** The

name is derived from the Greek *asyndetos* for unconnected, referring to the freely ending lateral darkenings.

**HOLOTYPE.** ♀, COSTA RICA: Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 6–11.vii.1993, B. Brown, D. Feener, Malaise trap #1 [LACM ENT 003497] (LACM).

**PARATYPES.** BRAZIL: Pará: Tucuruí, 3.83°S, 49.67°W, 1 ♀, 20.vii–8.viii.1982, J. Vidal, CDC trap (INPA); Roraima: Ilha de Maracá, 3.37°N, 61.43°W, 3 ♀, 2–13.v.1987, J. Rafael, Malaise trap (INPA, LACM). COSTA RICA: Guanacaste: 14 km S Cañas, 1 ♀, 24–31.v.1990, F.D. Parker (EMUS), Estación Pitilla, 11.0°N, 85.43°W, 1 ♀, iv.1989, P. Hanson, Malaise trap, 200 m (LACM), Santa Rosa National Park, 10.95°N, 85.62°W, 1 ♀, 21.ii–14.iii.1987, 3 ♀, 14.iii–4.iv.1987, I. Gauld and D. Janzen, Malaise trap, 300 m (LACM); Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 1 ♀, 17.v.1988, B. Brown, over *Gnamptogenys bispinosa* raided by *Eciton vagans* (LACM) 2 ♀, 21.i–3.ii.1991, J. Noyes, Malaise trap (LACM), 3 ♀, 15.iv.1993, ALAS, Malaise trap, M/01/64 (INBC), 1 ♀, 1–15.iv.1993, ALAS, Malaise trap, M/11/74 (INBC), 2 ♀, 15.iv–1.v.1993, ALAS, Malaise trap, M/8/87 (INBC), 16 ♀, 1–15.v.1993, ALAS, Malaise trap, M/04/83, M/8/102 (INBC), 2 ♀, 1–15.vi.1993, ALAS, Malaise trap, M/8/130 (INBC), 1 ♀, 6–11.vii.1993, B. Brown, D. Feener, Malaise trap #1 (LACM), 8 ♀, 15.x.1993, ALAS, Malaise trap M/09/243 (INBC), 1 ♀, 3.i.1994, ALAS, Malaise trap M/03/306 (INBC), 2 ♀, 4.iv.1994, ALAS, Malaise trap M/01/384, M/09/387 (INBC), 1 ♀, 2.i.1996, ALAS, Malaise trap M/01/531 (INBC), 1 ♀, 4.ix.1997, ALAS, Malaise trap M/17/679 (INBC), 1 ♀, 30.x.1997, ALAS, M/17/698 (INBC); Limón: 4 km NE Bribri, 9.63°N, 82.82°W, 1 ♀, vii–ix.1990, P. Hanson, Malaise trap, 50 m (LACM), Pandora, Estrella Valley, 1 ♀, 28.iii.1984, G.V. Manley, Malaise trap (LACM); Puntarenas: Cerro Rincon, 8.52°N, 83.47°W, 3 ♀, i.1991, 1 ♀, ii.1991, 1 ♀, iii.1991, P. Hanson, Malaise trap, 745 m (LACM), 24 km W Piedras Blancas, 8.77°N, 83.4°W, 1 ♀, x.1990, P. Hanson, Malaise trap, 200 m (LACM), 3 km SW Rincon, 8.68°N, 83.48°W, 2 ♀, ix–xi.1989, 1 ♀, x.1991, 8 ♀, xi.1991, P. Hanson, Malaise trap, 10 m (LACM, MUCR). ECUADOR: Pichincha, E. Santo Domingo [Tinalandia], 1 ♀, 8–14.v.1988, Bohart and Hanson (EMUS); Sucumbios: Sacha Lodge, 0.5°S, 76.5°W, 1 ♀, 4–14.iii.1994, 2 ♀, 24.v–3.vi.1994, 1 ♀, 27.viii–10.ix.1994, 2 ♀, 10–21.x.1994, 1 ♀, 21.xi–1.xii.1994, P. Hibbs, Malaise trap, 270 m (LACM, QCAZ). PANAMA: Darien: Cruce de Mono, 7.92°N, 77.62°W, 1 ♀, 6.ii–4.iii.1993, R. Cambra, J. Coronado, Malaise trap (LACM). PERU: Madre de Dios: Manu National Park, Cocha Cashu Station, 1 ♀, 23–30.viii.1986, D.C. Darling, Malaise trap, 380 m (ROME), Zona Reserva Pakitza, 11.94°S, 71.28°W, 1 ♀, 18.ii.1992, B. Brown, D. Feener, Malaise trap #4 (LACM) 4 ♀, 13–18.ii.1992, D. Quintero, Malaise trap (MIUP,

USNM), 1♀, 8.iii.1992, B. Brown, D. Feener, blacklight trap (LACM). TRINIDAD: Asa Wright Nature Center, 1♀, 15.i.1981, G.E. Bohart (EMUS).

### *Apocephalus catholicus* new species

(Fig. 93)

**SPECIES RECOGNITION.** This species is easily recognized by the apicodorsal region of the ovipositor, which has relatively broad lateral darkenings and medial sclerotization that expands posteriorly.

**DESCRIPTION.** Body length 1.1–1.6 mm. Frons yellow to dark brown, anterior margin relatively straight. One to two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 light brown to brown, round. Proboscis normal, small. Palpus yellow to brown. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta slightly enlarged, bristle-like. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.57 wing length; range 0.55–0.6. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow to gray. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with a few scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 93) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening broad, margin dark, complete. Dorsal apical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor wedge-shaped, posteriorly widened. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 wedge-shaped, narrowed toward apex but abruptly widened at apex. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite a simple, round loop.

**GEOGRAPHICAL DISTRIBUTION.** This species is known from lowland Brazil, Colombia, Costa Rica, Ecuador, and Panama.

**WAY OF LIFE.** Females of this species have been attracted to injured ants of a number of species, including *Ectatomma goninion* Kugler and Brown, *Odontomachus bauri*, *O. chelifera* (Latreille), *O. hastatus* (Fabricius), *O. laticeps*, *Pachycondyla crassinoda*, *P. harpax*, and *P. impressa*. All of the specimens collected at Bilsa Biological Station in Ecuador were feeders (see Behavioral Aspects).

At Bilsa, we conducted preference trials using *Pachycondyla impressa* and *Odontomachus bauri*. One bait with three injured *P. impressa* and one with three injured *O. bauri* was offered simultaneously. The number of flies landing on each bait was recorded for twelve 15-minute periods. According to these trials, the flies were much more attracted to injured *P. impressa* ( $\bar{x} = 2.25$  flies/trial)

than to injured *O. bauri* ( $\bar{x} = 0.33$  flies/trial); the difference was highly significant (99%;  $T = -4.60$ ,  $p = 0.0003$ ,  $df = 16$ ).

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for universal or general, referring to the wide variety of ants that attracted females of this species.

**HOLOTYPE.** ♀, COSTA RICA: Limón: 7 km SW Bribri, 9.58°N, 82.88°W, ix–xi.1989, P. Hanson, Malaise trap [LACM ENT 005282] (LACM).

**PARATYPES.** BRAZIL: Amazonas: Manaus, Reserva Ducke, 3.13°S, 60.02°W, 1♀, 8–15.iv.1992, Arm-Cola, 1-B-1 m, J. Vidal (INPA). COLOMBIA: Amazonas: 22 km NW Leticia, 0.4°S, 69.99°W, 1♀, 28.viii.1997, B. Brown, G. Kung, injured *Pachycondyla crassinoda* (LACM); Valle: Rio Raposo, 1♀, v.1965, V.H. Lee, light trap (USNM). COSTA RICA: Alajuela: La Virgen del Socorro, near Carriablanca, 1♀, 16.ii.1989, D. Grimaldi, P. DeVries, 700 m (AMNH); Guanacaste: Estación Pitilla, 11°N, 85.43°W, 2♀, 4.vii.1997, B. Brown, J. Paldi, injured *Odontomachus chelifera* (LACM); Heredia: La Selva Biological Station, 10.43°N, 84.02°W, 1♀, 15.iii–1.iv.1993, ALAS, Malaise trap M/10/57 (INBC), 1♀, 4.vii.1993, B. Brown, injured *Pachycondyla harpax* (LACM), 1♀, 15.i.1994, ALAS, Malaise trap M/08/326 (INBC), 1♀, 2.i.1996, ALAS, Malaise trap M/01/531 (INBC), Rara Avis, 12 km SW Horquetas, 1♀, 18–23.i.1989, D.A. Grimaldi, 550 m (AMNH); Limón: 4 km NE Bribri, 9.63°N, 82.82°W, 7♀, xii.1989–iii.1990, 1♀, vii–ix.1990, P. Hanson, Malaise trap, 50 m (LACM), 7 km SW Bribri, 9.58°N, 82.88°W, 2♀, ix–xi.1989, P. Hanson, Malaise trap (LACM), 16 km W Guapiles, 10.15°N, 83.92°W, 1♀, viii–ix.1989, 3♀, iii–v.1990, 2♀, i–iv.1991, P. Hanson, Malaise trap, 400 m (LACM); Puntarenas: Cerro Rincon, 8.52°N, 83.47°W, 1♀, ii.1991, P. Hanson, Malaise trap, 745 m (LACM), 3 km SW Rincon, 8.68°N, 83.48°W, 2♀, iii.1989, 1♀, ix–xi.1989, 1♀, xii.1991, P. Hanson, Malaise trap, 10 m (LACM, MUCR), 5 km SW Rincon, 8.7°N, 83.51°W, 8♀, 3.vi.1998, 16♀, 6.vi.1998, B. Brown, injured *Pachycondyla impressa* (LACM), 4♀, 3.vi.1998, B. Brown, injured *Odontomachus laticeps* (LACM), 2♀, 4.vi.1998, 2♀, 5.vi.1998, 4♀, 6.vi.1998, B. Brown, injured *Odontomachus bauri* (LACM). ECUADOR: Esmeraldas: Bilsa Biological Station, 0.34°N, 79.71°W, 1♀, 8.v.1996, B. Brown, injured *Ectatomma goninion* (LACM), 3♂, 20♀, 8.v.1996, B. Brown, injured *Pachycondyla impressa* (LACM, QCAZ, UNCB), 20♀, 8.v.1996, B. Brown, injured *Odontomachus bauri* (LACM, QCAZ), 1♀, 8.v.1996, B. Brown, injured *Odontomachus hastatus* (LACM), 1♀, 9.v.1996, B. Brown, injured *Odontomachus bauri* (LACM), 1♂, 19♀, 10.v.1996, B. Brown, injured *Pachycondyla impressa*, 500 m (LACM, MCZC, QCAZ), 2♀, 10.v.1996, B. Brown, injured *Odontomachus bauri* (LACM); Napo: Yasuni Biological Research Station, 0.67°S, 76.36°W, 1♀, 24.v.1996, B. Brown, injured *Pachycondyla crassinoda* (LACM); Pichin-



cha: Maquipucuna Biological Reserve, 0.12°N, 78.63°W, 1♀, 3.v.1996, B. Brown, injured *Pachycondyla impressa* (LACM), 47 km S Santo Domingo, Rio Palenque Science Center, 1♀, 2–4.v.1987, B. Brown, L.Coote, FIT, 180 m, primary rain forest (LACM), 17 km E Santo Domingo, Tinalandia, 3♀, 11.v.1987, B. Brown, injured *Pachycondyla impressa* (LACM). PANAMA: Darien: Cruce de Mono, 7.92°N, 77.62°W, 1♀, 6.ii–4.iii.1993, R. Cambra, J. Coronado, Malaise trap (MIUP).

*Apocephalus lyratus* Borgmeier

(Fig. 94)

*Apocephalus lyratus* Borgmeier, 1971:100; fig. 137.

**HOLOTYPE.** ♀, BRAZIL: Santa Catarina: Nova Teutonia, F. Plaumann [LACM ENT 122350] (MZSP; examined).

**SPECIES RECOGNITION.** This species is recognized by the broad, flat ovipositor with thin, light-colored lateral darkenings and a narrow sclerite between them.

**DESCRIPTION.** Borgmeier (1971) lists four male paratypes, but the manner in which they were associated with the females is unknown. Therefore, I am skeptical that they belong in the same species.

Body length 1.2–1.4 mm. Frons yellow, anterior margin relatively straight. Two pairs of supra-antennal setae present; lower pair markedly smaller than upper pair. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax yellow; pleuron yellow. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.47 wing length; range 0.46–0.5. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites yellow, posteriorly dark brown; tergite 6 completely yellow. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with several long setae on posterior margin. Venter of segments 3–5 with long, dense setae concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row. Ovipositor (Fig. 94) straight in lateral view, evenly sclerotized, with long, thin, posteromedial process dorsally. Lateral darkening thin, subparallel, apically divergent, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor concave. Apicoventral margin of ovipositor concave. Ovipositor without ventral postapical sclerite. Sternite 7 anteriorly rounded, dark, posteriorly narrow. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from Brazil and Ecuador.

**WAY OF LIFE.** Unknown.

**MATERIAL EXAMINED.** BRAZIL: Amazonas: Manaus, Reserva Ducke, 3.13°S, 60.02°W, 3♀, 8–15.iv.1992, Arm-Cola, 1-B-1 m, 2♀, 6–17.vii.1992,

10 m, J. Vidal (INPA, LACM); Santa Catarina: Nova Teutonia, 1♀, F. Plaumann (MZSP). ECUADOR: Sucumbios: Sacha Lodge, 0.5°S, 76.5°W, 1♀, 12–22.ii.1994, 1♀, 4–14.iii.1994, 1♀, 23.vi–3.vii.1994, 2♀, 16–27.viii.1994, 1♀, 27.viii–10.ix.1994, 2♀, 31.x–10.xi.1994, P. Hibbs, Malaise trap, 270 m (LACM, QCAZ).

*Apocephalus trifidus* new species

(Fig. 95)

**SPECIES RECOGNITION.** The distinctive ovipositor makes this species instantly recognizable: the median projection of the ovipositor is subequal in length and breadth to the lateral, sclerotized margins, making the apex of the ovipositor appear three-pronged.

**DESCRIPTION.** Body length 1.3–2.5 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, slightly pyriform (pointed). Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.56 wing length; range 0.53–0.59. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen gray to white. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 95) straight in lateral view, evenly sclerotized, with long, thin posteromedial process dorsally. Lateral darkening thin, subparallel, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 thin. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite with small opening and broad, moderately sclerotized process.

**GEOGRAPHICAL DISTRIBUTION.** This species is known from Brazil, Colombia, Ecuador, Guyana, and Peru. The host ant also has been recorded from French Guiana, Trinidad, and Venezuela.

**WAY OF LIFE.** Females of this species are attracted to, and oviposit in, injured *Pachycondyla crassinoda* workers. An average of 3.67 eggs were laid per host ( $n = 3$  oviposition events,  $sd = 1.16$  eggs), and larval feeding averaged 4.21 days ( $n = 14$  larvae,  $sd = 1.05$  days).

**DERIVATION OF SPECIFIC EPITHET.** The name is a Latin word for trifurcated, referring to the structure of the ovipositor.

**HOLOTYPE.** ♀, PERU: Madre de Dios: Zona Reserva Manu, Pakitzta, 27.ii.1992, B. Brown, D.

Feener, injured *Pachycondyla crassinoda* [LACM ENT 012199] (MUSM).

**PARATYPES.** BRAZIL: Pará: Belem, 1 ♀, ix.1970, T.H.G. Aitken, sticky trap (USNM); Roraima: Ilha de Maracá, 3.37°N, 61.43°W, 2 ♀, 2-13.v.1987, J. Rafael, Malaise trap (INPA, LACM). COLOMBIA: Amazonas: 22 km NW Leticia, 4.04°S, 69.99°W, 1 ♀, 26.viii.1997, 11 ♀, 27.viii.1997, 27 ♀, 28.viii.1997, 1 ♀, 6.ix.1997, B. Brown, G. Kung, injured *Pachycondyla crassinoda* (LACM, MCZC, MZSP, UNCB, USNM). ECUADOR: Napo: Yasuni Biological Research Station, 0.67°S, 76.36°W, 3 ♀, 21.v.1996, B. Brown, injured *Pachycondyla crassinoda* (LACM, QCAZ); Sucumbios: Añagu, 0.48°S, 76.38°W, 3 ♀, 9.ix.1997, P.J. DeVries, injured *Pachycondyla crassinoda* (LACM, QCAZ). GUYANA: Berbice: Dubulay Ranch, 5.68°N, 57.86°W, 3 ♀, 23.i.1999, B. Brown, injured *Pachycondyla crassinoda* (LACM), Warniabo Creek, Dubulay Ranch, 5.66°N, 57.88°W, 10 ♀, 16.i.1999, B. Brown, injured *Pachycondyla crassinoda* (LACM, UGGG). PERU: Madre de Dios, Zona Reserva Manu, Pakitza, 11.95°S, 71.28°W, 1 ♀, 13-18.ii.1992, D. Quintero, Malaise trap (MIUP), 2 ♀, 14.ii.1992, 4 ♀, 17.ii.1992, 5 ♀, 27.ii.1992, B. Brown, D. Feener, injured *Pachycondyla crassinoda* (LACM, MUSM), 1 ♀, 7.iii.1992, B. Brown, D. Feener, blacklight trap (LACM).

### *Apocephalus tanyurus* new species

(Fig. 96)

**SPECIES RECOGNITION.** This species has an extremely aberrant ovipositor. It can be recognized by the pair of large preapical sclerites and the unusual elongate shape of the other sclerotized portions of the ovipositor.

**DESCRIPTION.** Body length 1.6–1.8 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.49 wing length; range 0.47–0.5. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown, except tergite 6, which is partly to completely yellowish. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with long seta at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 short, consisting of a patch of setae, progressively increasing in size posteriorly. Ovipositor (Fig. 96) straight in lateral view, slightly sclerotized, but with small pair of darker preapical sclerites. Lateral darkening greatly elongate, posteriorly diverging, margin dark, complete. Dorsal apical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor

drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 broad, lightly sclerotized, with large lateral spine. Dufour's mechanism round. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from Ecuador and Colombia.

**WAY OF LIFE.** One female was attracted to an injured worker of *Paraponera clavata*.

**PHYLOGENETIC RELATIONSHIPS.** Based on the pair of preapical sclerites and the round Dufour's mechanism, this species might be an extremely aberrant member of the *A. paraponerae*-series.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Greek words *tany* and *oura*, for elongate and tail, referring to the elongate ovipositor.

**HOLOTYPE.** ♀, ECUADOR: Sucumbios: Sacha Lodge, 0.5°S, 76.5°W, 1–31.xii.1994, P. Hibbs, Malaise trap, 270 m [LACM ENT 050785] (LACM).

**PARATYPES.** COLOMBIA: Valle: Rio Raposo, 1 ♀, x.1964, V. Lee, light trap (USNM). ECUADOR: Sucumbios: Añagu, 0.48°S, 76.38°W, 1 ♀, 10.ix.1997, P. DeVries, injured *Paraponera clavata* (LACM), Sacha Lodge, 0.5°S, 76.5°W, 2 ♀, 10–21.x.1994, P. Hibbs, Malaise trap, 270 m (LACM, QCAZ).

### *Apocephalus contracticauda* new species

(Figs. 97–98)

**SPECIES RECOGNITION.** The narrow, elongate apex of the ovipositor is diagnostic for this species.

**DESCRIPTION.** Body length 1.3 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.43 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 bare. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of several setae in a straight row. Ovipositor (Figs. 97–98) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening thin, elongate, margin dark, complete. Dorsal apical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Abdominal glands in segment 5 white, inconspicuous in cleared speci-



mens. Internal sclerite rounded, with a short process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in eastern Costa Rica.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin words *contractus* and *cauda*, for narrow and tail, referring to the narrow apex of the ovipositor.

**HOLOTYPE.** COSTA RICA: Limon: 7 km SW Bribri, 9.58°N, 82.88°W, ix–xi.1989, P. Hanson, Malaise trap, 50 m [LACM ENT 005293] (LACM).

### *Apocephalus indistinctus* new species

(Fig. 99)

**SPECIES RECOGNITION.** This species has a heavily sclerotized ovipositor, similar to those of the *A. funditus*-subgroup species. It differs from them by the relatively straight line of the ovipositor in lateral view.

**DESCRIPTION.** Body length 1.1 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron yellow. Anterior scutellar seta large, bristle-like. Legs yellow; apex of hind femur slightly darker on anterior face. Mean costal length 0.48 wing length. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with long, scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Fig. 99) slightly sinuous in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening broadened, enlarging posteriorly, apically rounded, margin dark, complete. Dorsoapical sclerite of ovipositor rounded anteriorly. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Sternite 7 narrow but apically expanded. Dufour's mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite somewhat rectangular, with long, broad process.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single site in Amazonian Ecuador.

**WAY OF LIFE.** Unknown.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin words *in* and *distinctus*, for not and different, referring to the lack of a distinct sternite 7.

**HOLOTYPE.** ♀, ECUADOR: Sucumbios: Sacha Lodge, 0.5°S, 76.5°W, 14–24.iii.1994, P. Hibbs, Malaise trap, 270 m [LACM ENT 036449] (LACM).

### *Apocephalus dinoponeræ* new species

(Figs. 100–101)

**SPECIES RECOGNITION.** With its broad medial sclerite and black lateral darkenings, this species is similar to *A. kungæ*, with which it occurs. In *A. dinoponeræ*, however, the ovipositor is straight in lateral view, rather than curved upward as in *A. kungæ*.

**DESCRIPTION.** Body length 2–2.4 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present. Flagellomere 1 yellow, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta slightly enlarged. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.53 wing length; range 0.51–0.55. Wing vein  $R_{2+3}$  present. Halter brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 anteriorly emarginate, with short setae at posterolateral corner. Venter of segments 3–5 with short setae, concentrated medially. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 100–101) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, inner margin extended medially, margin dark, complete. Dorsoapical sclerite of ovipositor not differentiated. Apicodorsal margin of ovipositor rounded. Apicoventral margin of ovipositor drawn out into pointed process. Ovipositor without ventral postapical sclerite. Sternite 7 triangular. Dufour's mechanism elongate. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite a simple, round loop.

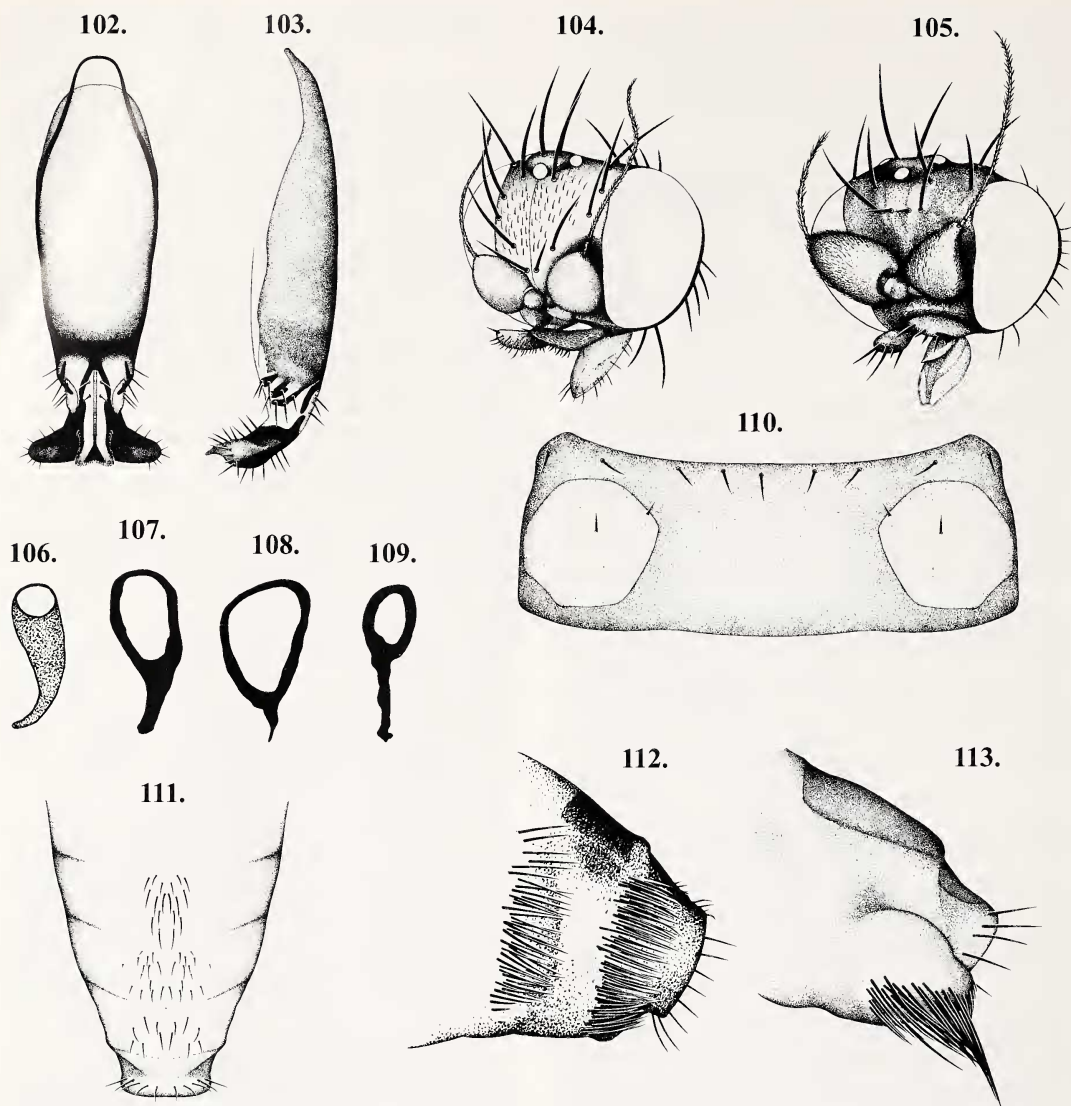
**GEOGRAPHICAL DISTRIBUTION.** Known only from southeastern Colombia. The host ant, *Dinoponera longipes*, is known from Brazil and Peru (Kempf, 1971).

**WAY OF LIFE.** Females, both egg-layers and feeders (see Behavioral Aspects), were attracted to injured workers of *Dinoponera longipes*. Four to nine eggs ( $n = 3$  oviposition events,  $\bar{x} = 6.00$  eggs,  $sd = 2.65$ ) were laid, usually through the suture between the propodeum and the petiole but on at least one occasion through the antennal suture in the head. Larvae finished feeding and emerged from the host after 1–7 days ( $n = 22$  larvae,  $\bar{x} = 4.00$  days,  $sd = 1.95$ ).

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the genus name of its host, *Dinoponera longipes*.

**HOLOTYPE.** ♀, COLOMBIA: Amazonas: 22 km NW Leticia, 4.04°S, 69.99°W, 28.viii.1997, B. Brown, G. Kung, injured *Dinoponera longipes* [LACM ENT 093676] (UNCB).

**PARATYPES.** COLOMBIA: Amazonas: Amacayacu National Park, 3.82°S, 70.26°W, 1♀, 4.ix.1997, 5♀, 5.ix.1997, B. Brown, G. Kung, in-



Figures 102–113. *Apocephalus* species. Figures 102–103. *Apocephalus latinsulosus* new species. 100. Dorsal. 101. Left lateral. Figures 104–105. Heads, anterolateral view. 104. *Apocephalus lopesi* (Borgmeier). 105. *Apocephalus brevifrons* new species. Figures 106–109. Internal, sclerotized loop. 106. *Apocephalus eurydomus* new species. 107. *Apocephalus flexus* new species. 108. *Apocephalus kungae* new species. 109. *Apocephalus petiolus* new species. Figure 110. Tergite 3, *Apocephalus maculosus* new species. Figure 111. Venter of abdomen, *Apocephalus eurydomus* new species. Figures 112–113. Segments 5 and 6 of abdomen, lateral. 112. *Apocephalus densepilosus* Borgmeier. 113. *Apocephalus comosus* new species.

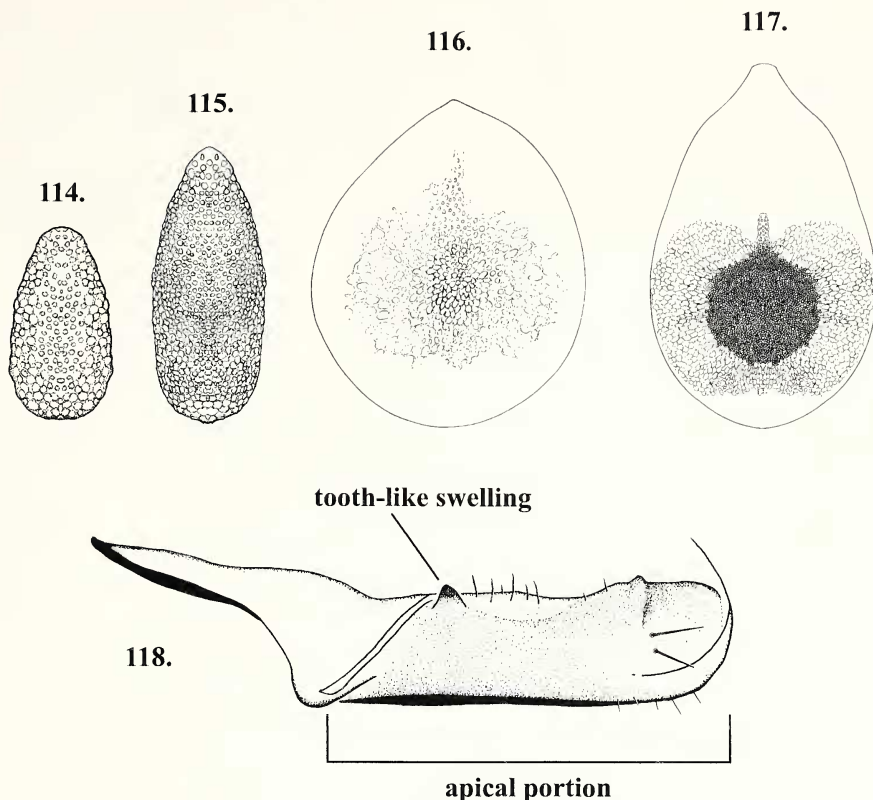
jured *Dinoponera longipes* (LACM), 22 km NW Leticia, 4.04°S, 69.99°W, 22♀, 27.viii.1997, 3♀, 28.viii.1997, 1♀, 7.ix.1997, B. Brown, G. Kung, injured *Dinoponera longipes* (LACM, MCZC, MZSP, UNCB, USNM).

***Apocephalus latinsulosus* new species**  
(Figs. 102–103)

**SPECIES RECOGNITION.** The small, separate lateral sclerites of the ovipositor are diagnostic for this species.

**DESCRIPTION.** Body length 1.9–2.5 mm. Frons yellow, anterior margin relatively straight. One pair of supra-antennal setae present (but one specimen has a second small pair). Flagellomere 1 light brown, round. Proboscis normal, small. Palpus yellow. Dorsum of thorax light brown; pleuron white. Anterior scutellar seta small, fine, subequal to posterior setulae of scutum. Legs yellowish-brown; apex of hind femur with abrupt darkening on anterior face. Mean costal length 0.63 wing length; range 0.61–0.67. Wing vein  $R_{2+3}$  present. Halter





Figures 114–118. *Apocephalus* species. Figures 114–117. Dufour's mechanisms. 114. *Apocephalus dichromatus* Brown. 115. *Apocephalus pseudocercus* Brown. 116. *Apocephalus* sp. 116 (unnamed *A. grandipalpis*-group species). 117. *Apocephalus paraponerae* Borgmeier. Figure 118. *Apocephalus fuscipalpis* Borgmeier. Ovipositor, lateral.

brown. Abdominal tergites dark brown. Venter of abdomen yellow. Abdominal tergites of normal form. Tergite 3 evenly colored. Tergite 6 completely divided, with short setae at posterolateral corner. Venter of segments 3–5 with a few scattered setae. Abdomen without dense lateral setae. Ventral setae of segment 6 long, consisting of a complete ventral and lateral row. Ovipositor (Figs. 102–103) straight in lateral view, lightly but evenly sclerotized dorsally. Lateral darkening posteriorly enlarged, truncate, margin dark, complete. Dorsal apical sclerite of ovipositor thin, triangular. Apicodorsal margin of ovipositor straight. Apicoventral margin of ovipositor straight. Ovipositor without ventral postapical sclerite. Ovipositor with small, separate sclerites posterolaterally. Sternite 7 narrow but apically expanded. Abdominal glands in segment 5 white, inconspicuous in cleared specimens. Internal sclerite not seen.

**GEOGRAPHICAL DISTRIBUTION.** Known from a single mid-elevation site in Costa Rica.

**WAY OF LIFE.** Females of this species were attracted to injured workers of the presumed host, *Pachycondyla impressa* (Roger). However, we observed no ovipositions; indeed, most of the females were without mature eggs and could not possibly

have parasitized hosts. They apparently were only interested in feeding (see Behavioral Aspects).

**PHYLOGENETIC RELATIONSHIPS.** This species is nearly a perfect intermediate between the *A. attophilus* and *A. miricauda*-groups. It has a highly differentiated apical sclerite that is nevertheless still articulated with the anterior portion of the ovipositor by a forked process in addition to the thin median strip. This multiple articulation is all that excludes it from the *A. attophilus*-group.

**DERIVATION OF SPECIFIC EPITHET.** The name is based on the Latin words *latus*, for side, and *insulosus*, for islands, referring to the many separate lateral sclerites on the ovipositor.

**HOLOTYPE.** ♀, COSTA RICA: Guanacaste: Estación Cacao, 10.93°N, 85.47°W, 30.vi.1997, B. Brown, injured *Pachycondyla impressa* [LACM ENT 093422] (LACM).

**PARATYPES.** COSTA RICA: Guanacaste: Estación Cacao, 10.93°N, 85.47°W, 2♀, ii.1989, P. Hanson, Malaise trap (LACM), 1♀, vii.1993, R.M. Guzman, 1♀, 12–17.vii.1993, F.A. Quesada (INBC), 2♀, 29.vi.1997, 7♀, 30.vi.1997, B. Brown, J. Paldi, E. Holscher, injured *Pachycondyla impressa* (LACM, MUCR).

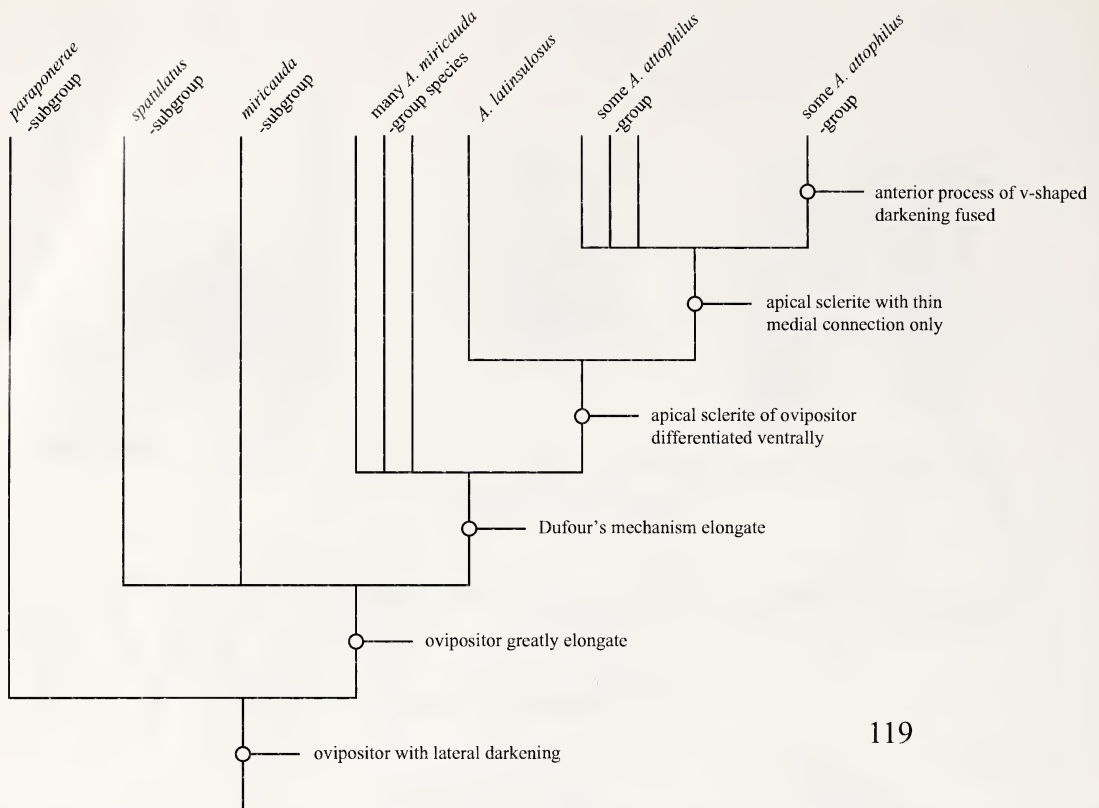


Figure 119. Hypothesis of relationships among *A. miricauda*-group and *A. atrophilus*-group taxa.

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# KEY TO FEMALES

Many species treated in this work are externally similar, with few characters to separate them besides those found in the female ovipositor. Therefore, dissection of the female abdomen will possibly be necessary to obtain an accurate identification.

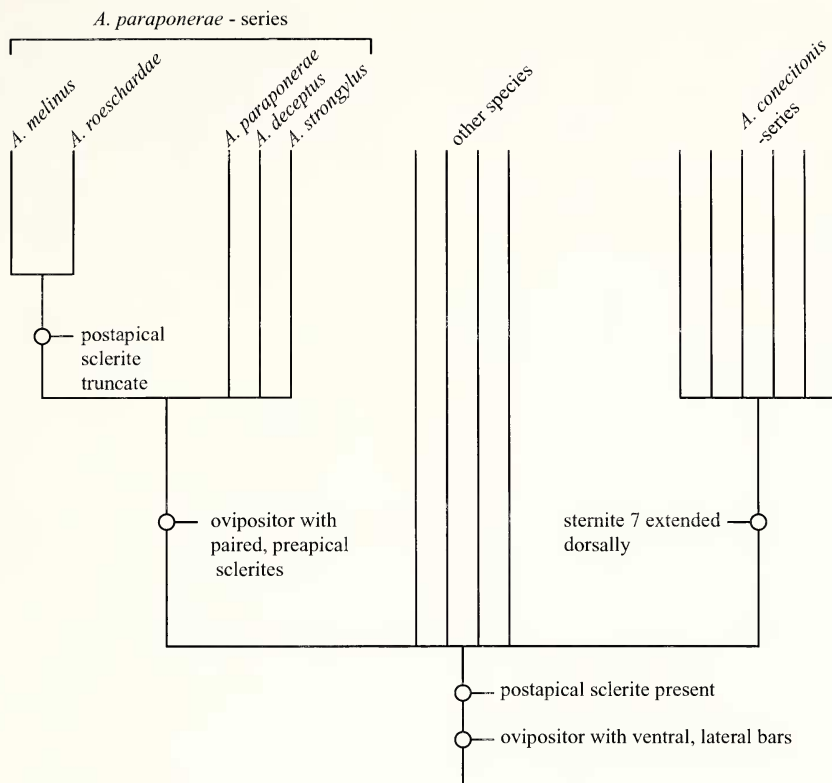
I did not examine specimens of *A. maculicauda* Borgmeier, a species that might belong in the *A. miricauda*-group.

The fossil species, *A. succineus*, is not included in this key.

- 1 Abdominal segments 4 and 5 with long lateral setae (Fig. 112); ovipositor as in Fig. 70, with small, medial preapical sclerite . . . . . *A. densepilosus* Borgmeier [*Pachycondyla crassinoda*; Amazon]
- Abdominal segments 4, and usually 5, bare laterally . . . . . 2
- 2 Abdominal segment 5 with dense patch of long setae on ventrolateral lobe (Fig. 113) . . . . . *A. comosus* new species [*Ectatomma tuberculatum*; Central America]
- Abdominal segment 5 without ventrolateral, lobe-like process bearing dense, long setae . . . 3
- 3 Frons with narrow anterior process bearing reclinate supra-antennal seta directly below lower

- interfrontal seta (Fig. 104) . . . . . *A. lopesi* (Borgmeier) [*Odontomachus haematodus*; Brazil, Colombia, Costa Rica, Guyana]
- Frons with straight anterior margin with normal, proclinate supra-antennal setae; if supra-antennal setae somewhat porrect or reclinate, then not located directly below lower interfrontal setae (Fig. 105) . . . . . 4
- 4 Ovipositor broad, with lateral darkenings well-defined, long (usually comprising about one-half of ovipositor length), subparallel, relatively narrow (Figs. 1–9); most species with a pair of preapical sclerites dorsally (Figs. 1, 3, 6), one with none (Fig. 8); ventrally ovipositor with separate, triangular, postapical sclerite with pointed (Figs. 2, 4) or truncate (Figs. 7, 9) apex . . . . . 5
- Ovipositor of most species thinner and more elongate, with lateral darkenings less defined, shorter, not parallel, or broader; 1–2 dorsal preapical sclerites present in some species, others with none; ventrally with or without separate postapical sclerite, which—if present—is always pointed . . . . . 8
- 5 Lateral darkenings of ovipositor yellowish-





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Figure 120. Hypothesis of relationships within *A. paraponerae*-subgroup.

brown in color; ovipositor posteriorly with pair of dark, round, preapical sclerites (Fig. 6); apex of ventral postapical sclerite truncate (Fig. 7)

..... *A. melinus* new species  
[*Dolichoderus attelaboides*; Amazon]

- Lateral darkenings of ovipositor black; ovipositor with or without dorsal preapical sclerites; apex of ventral postapical sclerite pointed or truncate ..... 6

- 6 Dorsally with area of moderate sclerotization reaching to apex and without preapical sclerites (Fig. 8); apex of ventral postapical sclerite truncate (Fig. 9); one pair of supra-antennal setae present ..... *A. roeschardae* new species

[*Cephalotes atratus*; Amazon]

- Dorsally with posterior portion of ovipositor relatively unsclerotized except for pair of small preapical sclerites; apex of ventral postapical sclerite pointed; two pairs of supra-antennal setae present ..... 7

- 7 Lateral darkenings relatively thin (Fig. 1); preapical pair of sclerites larger, darker; venter of abdominal segment 6 usually with only 2 setae (sometimes with up to four) ..... *A. paraponerae* Borgmeier

[*Paraponera clavata*, *Ectatomma tuberculatum*,

*Pachycondyla* spp.; widespread in lowlands of Neotropical Region]

- Lateral darkenings relatively thicker (Fig. 3); preapical pair of sclerites relatively thin, light-colored; venter of abdominal segment 6 with row of several setae ... *A. deceptus* new species

[*Pachycondyla commutata*; Ecuador]

- 8 Ovipositor spatulate (dorsally concave), apically upturned, often with lateral, upturned apices (Fig. 37); ovipositor usually without differentiated medial preapical sclerite, sometimes with lateral darkenings indistinct or not differentiated; ovipositor of most species with long posteroventral filament-like process (Fig. 40); in most species, apical region of darker sclerotization encircles entire ovipositor (Fig. 39) ... 9

- Ovipositor apically flat or convex, often with preapical sclerites; lateral darkenings usually distinctive; ovipositor without narrow, thread-like extension; ventral sclerotization not encircling entire sclerite ..... 23

- 9 Abdominal segments 3-5 bare ventrally ... 10

- Abdominal segments 3-5 with black setae ... 11

- 10 Intersegment 6-7 with sclerotized, black, clearly visible striations ..... 11

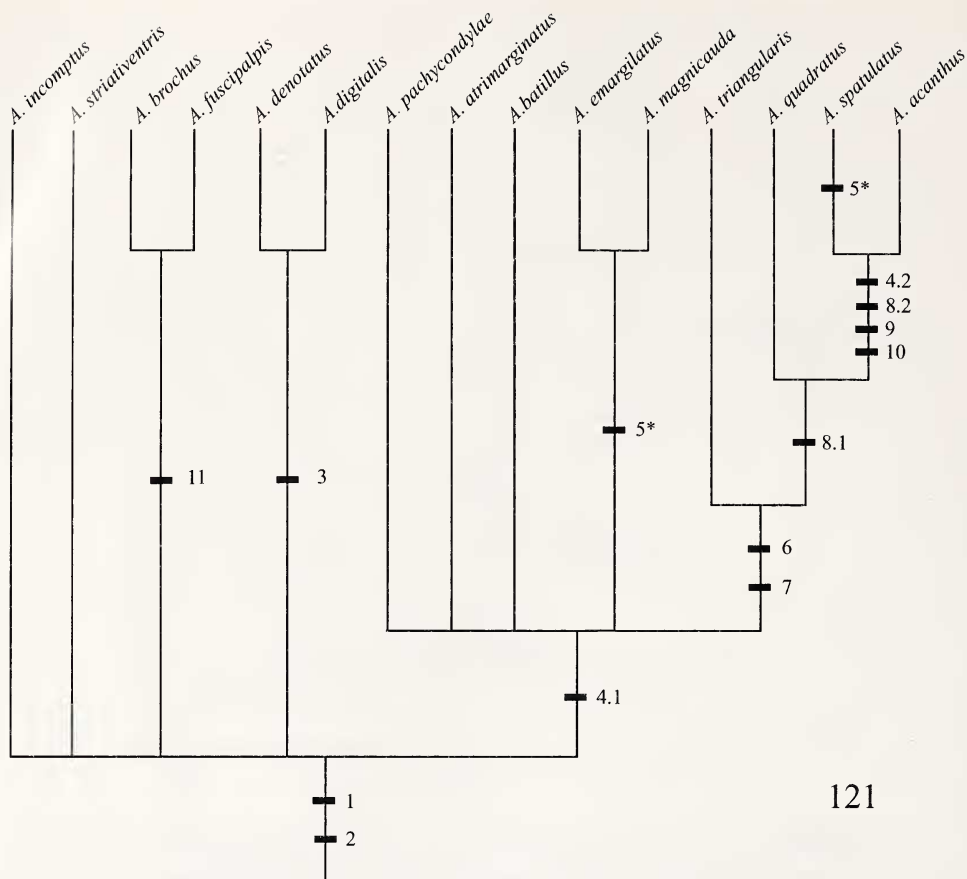


Figure 121. Hypothesis of relationships within *A. spatulatus*-subgroup.

- ..... *A. striativentris* new species  
[host unknown; Brazil, Costa Rica, Ecuador, Peru]
- Intersegment 6-7 without darkened striations  
..... *A. incomptus* new species  
[host unknown; Ecuador]
- 11 Abdominal setae dense, numerous, sometimes short ..... 12
- Abdominal setae scattered, relatively few, relatively long ..... 15
- 12 Ovipositor with dorsal spine (Fig. 45) ... 13
- Ovipositor without dorsal spine ..... 14
- 13 Posterolateral apex of ovipositor truncate (Fig. 44) ..... *A. acanthus* new species  
[host unknown; Costa Rica]
- Posterolateral apex of ovipositor right-angled (Fig. 46) ..... *A. spatulatus* Borgmeier  
[host unknown; Brazil]
- 14 Apical region of ovipositor triangular (Fig. 42) ..... *A. triangularis* new species  
[host unknown; Brazil, Mexico]
- Apical region of ovipositor quadrate (Fig. 43) ..... *A. quadratus* Brown  
[host unknown; Brazil, Ecuador]
- 15 Tergite 6 entire, not divided into two separate sclerites ..... 16
- Tergite 6 divided into two separate sclerites ... 17
- 16 Lateral margin of ovipositor smooth, not interrupted by emarginations (Fig. 41) ..... *A. magnicauda* new species  
[*Camponotus sericeiventris*; Ecuador, Peru]
- Lateral margin of ovipositor with emargination and tooth-like process in lateral view (Fig. 38) ..... *A. emargilatus* new species  
[*Camponotus sericeiventris*; Costa Rica]
- 17 Dorsal apex of ovipositor drawn out in long, narrow, parallel-sided process (Figs. 31-32) ... 18
- Dorsal apex of ovipositor without process of this type ..... 19
- 18 Dorsum of ovipositor with prominent, finger-like process (Fig. 31) ... *A. digitalis* Borgmeier  
[host unknown; Brazil]
- Dorsum of ovipositor without process (Fig. 32) ..... *A. denotatus* new species  
[host unknown; Costa Rica, Panama]
- 19 Apex of ovipositor narrowed, pointed (Fig. 30);



- laterodorsal tooth-like swelling present (Fig. 118) . . . . . 20
- Apex of ovipositor truncate (Figs. 33, 35, 36); ovipositor without tooth-like swelling . . . 21
- 20 Apex of ovipositor darkly sclerotized (Fig. 30) . . . . . *A. brochus* new species  
[*Camponotus banghaasi*, *C. rapax*; Brazil, Colombia]
- Apex of ovipositor not darkly sclerotized . . . . . *A. fuscipalpis* Borgmeier  
[host unknown; Brazil]
- 21 Posterolateral notch of ovipositor not prominent; lateral darkening of ovipositor short but distinct (Fig. 33) . . . . . *A. pachycondylae* new species  
[*Pachycondyla apicalis*, *P. obscuricornis*; Costa Rica]
- Ovipositor with well-differentiated posterolateral, raised notch (Fig. 37); lateral darkenings not distinct . . . . . 22
- 22 Posterodorsal apex of ovipositor with thick, black sclerotized margin (Fig. 35) . . . . . *A. atrimarginatus* new species  
[*Pachycondyla unidentata*; Costa Rica]
- Posterodorsal apex of ovipositor with at most thin dark margin (Fig. 36) . . . . . *A. batillus* new species  
[host unknown; Panama]
- 23 Ventral apex of ovipositor with well-developed, pointed, triangular postapical sclerite (Figs. 16, 18, 20, 24, 26) and lateral bars of sclerotization that extend medially (Fig. 18); dorsally without central preapical sclerite (but with small pair of sclerites in one species; Fig. 5); lateral darkenings of some species thickened, rounded, and projecting laterally (Figs. 6, 11, 13) . . . . . 24
- Ventral apex of ovipositor usually truncate; lacking postapical sclerite and lateral bars; dorsally, in some species with differentiated central preapical sclerite (one species with aberrant paired sclerites) (Fig. 96); lateral darkenings otherwise . . . . . 36
- 24 Posterodorsal apex of ovipositor concave, with thin, medial process (Fig. 14); ovipositor distinctly constricted in middle; ventrally with well-developed, prominent triangular pointed apex . . . . . *A. dracodermus* new species  
[host unknown; Peru]
- Ovipositor not as above . . . . . 25
- 25 Ovipositor broad and triangular in appearance, broadest at apex (Fig. 21) . . . . . *A. persecutor* Borgmeier  
[host unknown; Brazil, Costa Rica, Ecuador]
- Ovipositor more parallel-sided, usually broadest at midlength of lateral darkenings . . . 26
- 26 Lateral darkenings relatively straight, not giving ovipositor a rounded appearance (Figs. 10, 19, 23, 25, 27), although one species with small, rounded apical lobes . . . . . 27
- Lateral darkenings curved, giving posterior one-third of ovipositor a rounded appearance (Figs. 5, 11, 13, 15, 17, 22) . . . . . 31
- 27 Venter of segments 4–5 bare; postapical sclerite extremely short, triangular-shaped (Fig. 26) . . . . . *A. spiculus* new species  
[host unknown; Panama]
- Venter of segments 4–5 with black setae; postapical sclerite of various forms . . . . . 28
- 28 Lateral darkenings rounded, thickened, lobe-like (Fig. 27); venter of abdomen with row of setae present on segments 4–6 . . . . . *A. torulus* new species  
[host unknown; Colombia, Ecuador]
- Lateral darkenings thin; ventral setation of abdomen various . . . . . 29
- 29 Dorsum of ovipositor with reticulate sculpture, medially light-colored (Fig. 19); venter of ovipositor with forked, anteriorly projecting process (Fig. 20) . . . . . *A. reticulatus* new species  
[host unknown; Costa Rica]
- Dorsum of ovipositor smooth, without reticulate sculpture; ventrally without forked process . . . . . 30
- 30 Ovipositor medially darkened; laterally parallel-sided, with apical darkenings not divergent (Fig. 10); venter of abdominal segment 6 with row of long setae, segments 4–5 with relatively small, black setae . . . . . *A. conecitonis* new species  
[host unknown, but usually found with army ants; Costa Rica]
- Ovipositor not medially darkened; laterally with small expansion, apical darkenings slightly divergent (Fig. 23); venter of abdominal segment 6 with row of long setae, segments 4–5 with few, short, almost invisible setae . . . . . *A. secus* new species  
[host unknown; Costa Rica]
- 31 Venter of ovipositor with dark-colored, posteriorly expanded, triangular sclerite (Fig. 12); dorsum of ovipositor as in Fig. 11 . . . . . *A. constrictus* new species  
[host unknown; Costa Rica]
- Venter of ovipositor without a well-defined sternite . . . . . 32
- 32 Venter of abdominal segments 3–5 with dense long setae, especially medially; lateral darkenings extremely broad, black (Fig. 13) . . . . . *A. crassilatus* new species  
[*Pachycondyla* spp.; widespread in Neotropical lowlands]
- Venter of abdominal segments 3–5 with at most thin, short, scattered setae; lateral darkenings various . . . . . 33
- 33 Ovipositor dorsally with small preapical sclerites (Fig. 5); expanded portion of ovipositor more than twice as broad as rest of ovipositor; frons with two pairs of subequal supra-antennal setae . . . . . *A. strongylus* new species  
[host unknown; Brazil]
- Ovipositor without preapical sclerites; expanded portion less than twice as broad as rest of ovipositor; frons at most with a smaller, lower pair of supra-antennal setae (most species with only one pair) . . . . . 34

- 34 Ovipositor with medial, moderately sclerotized triangular area dorsally (Fig. 22) .....  
*A. curtinotus* new species  
[host unknown; Brazil]
- Ovipositor without medial sclerotization ... 35
- 35 One pair of supra-antennal setae present. Ventrally, ovipositor with transverse, posterior sclerites not touching (Fig. 18); postapical sclerite elongate; tergite 6 only slightly emarginate anteriorly; posteriorly with large pair of setae .....  
*A. inpalpabilis* new species  
[host unknown; Costa Rica]
- A second, extremely small pair of supra-antennal setae present. Ventrally, ovipositor with transverse sclerites joined to form a single structure (Fig. 16); postapical sclerite short, broad; tergite 6 deeply emarginate anteriorly; posteriorly with less differentiated pair of setae .....  
*A. indeptus* new species  
[host unknown; Costa Rica]
- 36 Ovipositor curved dorsally at midlength (Fig. 49); sternite 7 with lateral fringe of small processes (Fig. 48) ..... 37
- Ovipositor relatively straight or curved ventrally at midpoint in lateral view; sternite 7 without lateral processes ..... 40
- 37 Sternite 7 extremely broad, posteriorly exceeding width of dorsum of ovipositor (Fig. 47); two pairs of supra-antennal setae .....  
*A. miricauda* Borgmeier  
[*Dinoponera gigantea*; Brazil]
- Sternite 7 narrower, not exceeding width of dorsum of ovipositor; one pair of supra-antennal setae ..... 38
- 38 Without separate dorsal preapical sclerite; instead, broad, sclerotized lobe extending to apex (Fig. 50); sternite 7 with posterior rounded expansion extending across most of segment; sclerotized loop relatively small .....  
*A. kungae* new species  
[*Dinoponera longipes*; Colombia]
- Ovipositor with distinct preapical sclerite (Figs. 51, 53); sternite 7 much narrower, only slightly expanded posteriorly; sclerotized loop extremely large or small ..... 39
- 39 Sclerotized loop extremely large, over one-half width of ovipositor (Fig. 51) .....  
*A. flexus* new species  
[host unknown; Ecuador]
- Sclerotized loop much smaller than one-half width of ovipositor (Fig. 53) .....  
*A. orbiculus* new species  
[host unknown; Costa Rica]
- 40 Dorsum of ovipositor with separate (i.e., not anteriorly attached to other sclerites), single distinct preapical sclerite (e.g., Fig. 78) ..... 41
- Sclerites of ovipositor various (Figs. 54, 55, 57, 58, 60, 62, 64, 71), but not as above ..... 56
- 41 Lateral darkenings extremely broad, thickened (Figs. 67, 68, 72) ..... 42
- Lateral darkenings narrower ..... 44
- 42 Lateral darkenings rounded, lobe-like (Fig. 72); ventral apex of ovipositor without dark, heavily sclerotized plate; frons subequal in length and width .....  
*A. lobicauda* new species  
[*Ectatomma tuberculatum*; Costa Rica]
- Lateral darkenings shaped differently; ventral apex of ovipositor with dark-colored, heavily sclerotized median sclerite; frons short ... 43
- 43 Dorsal preapical sclerite narrow, much longer than broad (Fig. 67) .....  
*A. spatulicauda* Borgmeier  
[host unknown; Brazil]
- Dorsal preapical sclerite broader than long (Fig. 68) .....  
*A. inimicus* Borgmeier  
[host unknown; Brazil]
- 44 Preapical sclerite large, oval, shiny (Fig. 73) .....  
*A. globosus* new species  
[*Pachycondyla villosa*; Costa Rica]
- Preapical sclerite not oval, trapezoidal in most species (Figs. 74–78) ..... 45
- 45 Ovipositor, in lateral view, strongly downturned at midlength (as in Fig. 65); ovipositor dorsally as in Fig. 66 .....  
*A. intonsus* new species  
[host unknown; Panama]
- Ovipositor, in lateral view, straight or only slightly deflected at apex ..... 46
- 46 Abdominal tergite 3 with lateral, round light patch (Fig. 110); venter of abdomen with small patch of short setae mediolaterally on segment 5, otherwise 3–5 bare .....  
*A. maculosus* new species  
[host unknown; Ecuador]
- Abdominal tergite 3 uniformly dark-colored; abdominal setation various but not as above ... 47
- 47 Anterior margin of preapical sclerite deeply cleft (Figs. 74–78) ..... 48
- Anterior margin of preapical sclerite entire (Figs. 80, 82, 83) ..... 51
- 48 Venter of abdomen bare; apices of lateral darkening not markedly convergent posteriorly (Figs. 75–76); sclerotized loop with broad process (Fig. 106) ..... 49
- Venter of abdomen setose; apices of lateral darkening markedly convergent posteriorly (Figs. 77–78); sclerotized loop with long, narrow process (Fig. 109) ..... 50
- 49 Dorsal preapical sclerite broadly and deeply cleft (Fig. 75); apex of ovipositor flat .....  
*A. glabriventris* new species  
[*Ectatomma tuberculatum*; Mexico]
- Dorsal preapical sclerite with narrow cleft (Fig. 76); apex of ovipositor downturned .....  
*A. minutus* Borgmeier  
[host unknown; Brazil]
- 50 Ventral setae of abdominal segments 3–5 short, about one-half length of long ventral setae on posterior margin of segment 6; tergite 6 divided .....  
*A. cardiacus* new species  
[host unknown; Costa Rica]
- Ventral setae of abdomen long, dense, giving it a markedly “hairy” appearance; ventral setae subequal in length to ventral setae on posterior

- margin of segment 6; tergite 6 entire ..... *A. petiolus* new species  
[host unknown; Costa Rica]
- 51 Preapical sclerite much longer than wide, anteriorly rounded (Fig. 80); sternite 7 broad, triangular (Fig. 81) ..... *A. gigantivorus* new species  
[*Dinoponera gigantea*; Brazil]
- Preapical sclerite about as long as wide, anterior margin not rounded (Figs. 82–83); sternite 7 various ..... 52
- 52 Apices of lateral darkening markedly convergent posteriorly (Figs. 83, 85, 87, 89) ... 53
- Apices of lateral darkening not convergent posteriorly (Fig. 82) .... *A. piliventris* Borgmeier  
[*Pachycondyla striata*; Brazil]
- 53 Preapical sclerite posteriorly cleft (Fig. 83); sternite 7 thin triangular, with medial dark strip that projects posteriorly from triangular base, making apex appear three-pronged (Fig. 84); sclerotized loop large, about one-half width of ovipositor, similar in shape to Fig. 107 ..... *A. annulatus* new species  
[host unknown; Costa Rica]
- Preapical sclerite not cleft posteriorly; sternite 7 not appearing three-pronged ..... 54
- 54 Sternite 7 distinctive: anteriorly broad, then narrowed and expanded posteriorly, with numerous marginal setae and with apex of medial black thickening enlarged; posteriorly narrowed and again expanded to width of ovipositor (Fig. 83) ... *A. contortiventris* new species  
[*Pachycondyla impressa*; Ecuador]
- Sternite 7 not as above; medial black thickening, when present, not apically expanded ... 55
- 55 Sternite 7 apically expanded (Fig. 88) ..... *A. eurydomus* new species  
[*Pachycondyla harpax*; Costa Rica, Panama, USA]
- Sternite 7 not expanded apically (Fig. 90) ... *A. conformalis* new species  
[host unknown; Brazil]
- 56 Single preapical sclerite present but attached to anterior end of lateral darkenings by a distinctive sclerotized bar (Figs. 54, 55, 57, 58); most species with lateral postapical sclerites (e.g., Fig. 55) ..... 57
- Preapical sclerites, if present, not attached to anterior end of lateral darkenings (Figs. 91–97, 99–100, 102); lateral postapical sclerites absent ..... 61
- 57 Venter of abdomen with numerous long setae, giving it a “hairy” appearance ..... 58
- Venter of abdomen with shorter and fewer setae, mostly concentrated medially ..... 59
- 58 Preapical sclerite and lateral bars forming relatively smooth anterior margin (Fig. 54); lateral postapical sclerites absent ..... *A. meniscus* new species  
[host unknown; Peru]
- Preapical sclerite projecting anteriorly (Fig. 55); lateral postapical sclerites present ..... *A. barbiventris* new species  
[*Odontomachus barbiventris*; Costa Rica]
- 59 Preapical sclerite extremely large, filling much of space between lateral darkenings (Fig. 57) ..... *A. amplidiscus* new species  
[host unknown; Costa Rica]
- Preapical sclerite small, discrete, with anteriorly directed bars of sclerotization attaching to anterior end of lateral darkenings (Figs. 58, 60) ..... 60
- 60 Sternite 7 broad triangular (Fig. 59) ..... *A. paldiae* new species  
[*Odontomachus chelifer*; Costa Rica]
- Sternite 7 anteriorly rounded, narrowing posteriorly (Fig. 61) .. *A. cyclodiscus* new species  
[host unknown; Panama]
- 61 Ovipositor with oval, window-like clear areas (Fig. 91) ..... *A. fenestratus* new species  
[host unknown; Costa Rica]
- Ovipositor without oval clear areas ..... 62
- 62 Wing vein  $R_{2+3}$  absent; lateral darkenings of ovipositor extremely broad, triangular (Fig. 69); frons short (Fig. 105) ..... *A. brevisfrons* new species  
[host unknown; Costa Rica, Mexico]
- Wing vein  $R_{2+3}$  present; lateral darkenings not so broad (except *A. latinsulosus* (Fig. 102), which differs by having small lateral sclerites); frons about as long as wide ..... 63
- 63 Lateral darkenings downturned, projecting posterolaterally, apparently ending free of rest of ovipositor (Fig. 92) ..... *A. asyndetus* new species  
[*Gnamptogenys bispinosus*; widespread in Neotropical lowlands]
- Lateral darkenings not strongly downturned and not ending freely ..... 64
- 64 Lateral darkenings separated by posterior process of ovipositor, which expands posteriorly to fill entire space between them (Fig. 93) ..... *A. catholicus* new species  
[*Pachycondyla crassinoda*, *harpax*, *impressa*, *Odontomachus* spp.]
- Ovipositor not as above ..... 65
- 65 Long, thin sclerite subequal in size to lateral darkenings extending posteriorly between them (Figs. 94–95) ..... 66
- Ovipositor without long, narrow sclerite extending between lateral darkenings ..... 67
- 66 Lateral darkenings lightly sclerotized, yellowish-brown in color, extending posteriorly, so that posterior margin of ovipositor is concave (Fig. 94); posterior margin of tergite 6 with three or more thick setae that are as long as tergite ..... *A. lyratus* Borgmeier  
[host unknown; Brazil, Ecuador]
- Lateral darkenings heavily sclerotized, almost black in color, not extending posteriorly past apex of ovipositor (Fig. 95); posterior margin of tergite 6 with one or two thinner setae that are clearly shorter than length of tergite ..... *A. trifidus* new species



- [*Pachycondyla crassinoda*; Brazil, Colombia, Ecuador, Peru]
- 67 Ovipositor elongate, with long, thin sclerites and a pair of preapical sclerites (Fig. 96); venter of abdominal segment 6 with large patch of several rows of setae that increase in length posteriorly; venter of other abdominal segments bare . . . . . *A. tanyurus* new species [Paraponera clavata; Colombia, Ecuador]
- Ovipositor and ventral setation not as above . . . . . 68
- 68 Lateral darkenings strongly expanded posteriorly (Fig. 102); ovipositor with lateral, isolated sclerites (Fig. 103) . . . . . *A. latinsulosus* new species [Pachycondyla impressa; Costa Rica]
- Lateral darkenings, if slightly expanded posteriorly, without lateral sclerites . . . . . 69
- 69 Entire ovipositor, including space between lateral darkenings, dark brown, shiny (Fig. 64); ovipositor strongly downturned at midlength (Fig. 65) . . . . . *A. funditus* new species [host unknown; widespread Neotropical Region]
- At least some portion of ovipositor not dark brown and shiny (Figs. 97, 99, 100); not downturned . . . . . 70
- 70 Apical portion of ovipositor narrow; lateral darkenings thin, subparallel; space between lateral darkenings subequal to thickness of lateral darkenings (Fig. 97) . . . . . *A. contracticauda* new species [host unknown; Costa Rica]
- Apical portion of ovipositor relatively broad (Figs. 66, 100) and shaped differently . . . 71
- 71 Lateral darkenings apically expanded, separated by rounded sclerite (Fig. 99); venter of ovipositor evenly sclerotized, without distinct sternite . . . . . *A. indistinctus* new species [host unknown; Ecuador]
- Lateral darkenings not expanded apically, separated by broad, lightly sclerotized region (Fig. 100); ventrally with triangular sternite, expanded posteriorly (Fig. 101) . . . . . *A. dinoponerae* new species [Dinoponera longipes; Colombia]

# BEHAVIORAL ASPECTS

Females of most species had a stereotyped behavior, similar to that described for *A. paraponerae* (Brown and Feener, 1991a). They were attracted to crushed, injured workers of their host ant species (Table 2 is a list of crushed ants and the flies that have been attracted to them), as were males. Individuals of both sexes approached hosts, but males did not remain for long periods of time. A female will approach the host, walk over it, and follow one of two routines: either she will quickly (within about 15 seconds) begin to probe with her ovipositor and attempt to lay eggs (“layers”) or she will feed on hemolymph from the crushing wounds of

Table 2. List of ant species that, when injured, have attracted *A. miricauda*-group parasitoids (some species, marked with an asterisk, are attracted to healthy, noninjured hosts).

| Ant host                         | <i>Apocephalus</i> parasitoid |
|----------------------------------|-------------------------------|
| <i>Camponotus banghaasi</i>      | <i>brochus</i> *              |
| <i>C. rapax</i>                  | <i>brochus</i> *              |
| <i>C. sericeiventris</i>         | <i>emargilatus</i>            |
| <i>C. sericeiventris</i>         | <i>magnicauda</i> *           |
| <i>Cephalotes atratus</i>        | <i>catholicus</i>             |
| <i>C. atratus</i>                | <i>roeschardae</i>            |
| <i>Dinoponera gigantea</i>       | <i>gigantivorus</i>           |
| <i>D. gigantea</i>               | <i>miricauda</i>              |
| <i>D. longipes</i>               | <i>dinoponerae</i>            |
| <i>D. longipes</i>               | <i>kungae</i>                 |
| <i>Dolichoderus attelaboides</i> | <i>catholicus</i>             |
| <i>D. attelaboides</i>           | <i>melinus</i>                |
| <i>D. attelaboides</i>           | <i>paraponerae</i>            |
| <i>D. decollatus</i>             | <i>melinus</i>                |
| <i>Ectatomma gonion</i>          | <i>catholicus</i>             |
| <i>E. lugens</i>                 | <i>paraponerae</i>            |
| <i>E. tuberculatum</i>           | <i>comosus</i>                |
| <i>E. tuberculatum</i>           | <i>lobicauda</i>              |
| <i>E. tuberculatum</i>           | <i>paraponerae</i>            |
| <i>Odontomachus bauri</i>        | <i>catholicus</i>             |
| <i>O. chelifer</i>               | <i>catholicus</i>             |
| <i>O. chelifer</i>               | <i>paldiae</i>                |
| <i>O. haematodus</i>             | <i>lopesi</i>                 |
| <i>O. hastatus</i>               | <i>catholicus</i>             |
| <i>Pachycondyla apicalis</i>     | <i>crassilatus</i>            |
| <i>P. apicalis</i>               | <i>paraponerae</i>            |
| <i>P. commutata</i>              | <i>deceptus</i>               |
| <i>P. commutata</i>              | <i>melinus</i>                |
| <i>P. crassinoda</i>             | <i>catholicus</i>             |
| <i>P. crassinoda</i>             | <i>densepilosus</i>           |
| <i>P. crassinoda</i>             | <i>paraponerae</i>            |
| <i>P. crassinoda</i>             | <i>trifidus</i>               |
| <i>P. harpax</i>                 | <i>catholicus</i>             |
| <i>P. impressa</i>               | <i>catholicus</i>             |
| <i>P. impressa</i>               | <i>crassilatus</i>            |
| <i>P. impressa</i>               | <i>latinsulosus</i>           |
| <i>P. striata</i>                | <i>piliventris</i>            |
| <i>P. unidentata</i>             | <i>atrimarginatus</i>         |
| <i>P. unidentata</i>             | <i>crassilatus</i>            |
| <i>P. villosa</i>                | <i>crassilatus</i>            |
| <i>P. villosa</i>                | <i>globosus</i>               |
| <i>P. villosa</i>                | <i>paraponerae</i>            |
| <i>Paraponera clavata</i>        | <i>paraponerae</i>            |
| <i>P. clavata</i>                | <i>tanyurus</i>               |

the ant (“feeders”). Feeders were not seen to oviposit, and those examined closely were found to be incapable of oviposition because they had no mature eggs in their ovaries. This is reminiscent of an observation by Disney (1994), that most carrion-feeding female phorids were not gravid. After ovipositing, layers often would quickly leave the host but sometimes would also stay to feed.

Little work has been done on the development of

sexual maturity in adult phorid flies, so it is not known if most phorids are able to develop eggs prior to feeding or if they require some sort of protein meal to produce their eggs. Other workers have found that carbohydrate meals (sugar) increased fecundity of *Megaselia halterata* (Wood), but it was not found to be an absolute necessity (Binns, 1980). Difficulties in keeping *Apocephalus* females alive in culture might make similar studies problematic, but there is at least an indication that these flies require a meal of hemolymph before eggs can be matured.

In contrast to other *A. miricauda*-group species, the *A. spatulatus*-subgroup species *A. brochus* and *A. magnicauda* attacked healthy, living hosts. In particular, we saw *A. brochus* appear to be attempting to oviposit in the back of the heads of the host ants. The hosts of both of these species, *Camponotus* spp., are highly divergent from those of other *A. miricauda*-group taxa; therefore, it is possible that the shift in behavior was accompanied by the shift in host. The only specimen of *A. emarginatus*, the sister-species of *A. magnicauda*, that was collected from a host was attracted to an injured worker of *Camponotus sericeiventris*, however. This lends support to a scenario where, in *A. magnicauda* only, the host shift occurred first, and then the shift to attacking uninjured ants. Much further research is necessary to resolve these issues.

The other species of this group to have radically shifted their hosts, *A. melinus* and *A. roeschardae*, are possibly also each other's closest relatives. Each behaves in a similar manner to *A. paraponerae*, attacking injured hosts exclusively. It would be interesting to compare the chemical components of the mandibular glands of the hosts of these two species with those of *Paraponera clavata*. Apparently the chemicals of *Dolichoderus attelaboides* are similar enough to those of ponerine ants to occasionally attract species such as *A. paraponerae* and *A. catholicus* (Table 2).

ACKNOWLEDGMENTS

Jesse Cantley expertly produced the illustrations for this paper. Technical assistance was rendered by Vladimir Berezovskiy. For help with field work in Ecuador, I thank Jesse Cantley, Peter Hibbs, and Jacqueline Röschar; for permission to do research there, I thank the Fundacion Maquipucuna, Fundacion Jatun Sacha, and the Catholic University (especially Dr. Giovanni Onore). For help with field work in Costa Rica, I thank Jesse Cantley, Erik Holscher, and Jill Paldi; for permission to do research there, I thank the Organization for Tropical Studies, the Arthropods of La Selva (ALAS) Project, and the Instituto Nacional de Biodiversidad (especially Manuel Zumbado). For help with field work in Colombia, I thank Giar-Ann Kung; for help obtaining permission to do research there, I thank Fernando Fernandez, Diego Campos, and Mike Sharkey. For help obtaining permission to do field work in Peru, I thank the Smithsonian BIOLAT program and Dr. Gerardo Lamas. In Guyana I was aided by Carol Kelloff of the Smithsonian Institution's Biodiversity in the Guyanas project, Mike Tamessar, Diante Nerine, and Alex

and Adriana Mendes. For material from Panama I thank Diomedes Quintero and John Pickering.

This research was funded by grants from the Canadian Natural Sciences and Engineering Research Council to B. Brown and G.E. Ball, the Mellon Foundation, the Weiler Foundation (to the Natural History Museum of Los Angeles County), the Smithsonian Institution BIOLAT program, and National Science Foundation (NSF) grant DEB-9407190 to B. Brown. NSF grants BSR-9025024, DEB-9401069, and DEB-9706976 funded the ALAS project; grants DEB-9522581, DEB-96421221, and the Smithsonian Environmental Sciences Program supported John Pickering.

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Received 7 April 1999; accepted 2 November 1999.



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